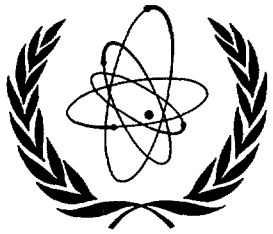

International Atomic Energy Agency

ANNUAL REPORT OF THE BOARD OF GOVERNORS TO THE GENERAL CONFERENCE

1 July 1965 - 30 June 1966

GC(X)/330

Printed by the
International Atomic Energy Agency
in Austria - July 1966

CONTENTS

ANNEXES

List of abbreviations

Agency	International Atomic Energy Agency
COMECON	Council for Mutual Economic Assistance
ECAFE	United Nations Economic Commission for Asia and the Far East (of ECOSOC)
ECOSOC	Economic and Social Council of the United Nations
ENEA	European Nuclear Energy Agency of the Organisation for Economic Co-operation and Development
EPTA	United Nations Expanded Programme of Technical Assistance
EURATOM	European Atomic Energy Community
FAO	Food and Agriculture Organization of the United Nations
IAEA	International Atomic Energy Agency
IANEC	Inter-American Nuclear Energy Commission of the Organisation of American States
IATA	International Air Transport Association
ICRP	International Commission on Radiological Protection
ICSU	International Council of Scientific Unions
ILO	International Labour Organisation or International Labour Office
IMCO	Inter-Governmental Maritime Consultative Organization
OAU	Organisation of African Unity
OECD	Organisation for Economic Co-operation and Development
UNDP	United Nations Development Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNSCEAR	United Nations Scientific Committee on the Effects of Atomic Radiation
WHO	World Health Organization
WMO	World Meteorological Organization

NOTE

All sums of money are expressed in United States dollars.

INTRODUCTION

1. The Board of Governors [1] presents to the General Conference the following report on the Agency's work from 1 July 1965 to 30 June 1966. This year's report follows generally the structure of the Agency's Programme for 1965-66 [2], thus making reference between the two documents easier. It should be borne in mind, however, that the programme covers the two-year period from 1 January 1965 to December 1966 while this report covers the period from 1 July 1965 to 30 June 1966.

(a) The programme

2. The year has been marked by further growth in the Agency's safeguards activities and of the Agency's safeguards system. In September 1965 the Board gave its final approval to the revised safeguards system. In June 1966 it provisionally approved the special procedures for safeguarding reprocessing plants, as an annex to the Agency's Safeguards System (1965) [3]. During the period under review the number of safeguards agreements approved by the Board increased from 24 to 29. One new agreement covers a major nuclear power station in the United Kingdom of Great Britain and Northern Ireland.

3. Integrated country programming is enabling the Agency to fit all its types of technical assistance more closely to the needs of Member States, although some countries still have difficulty in adjusting to new arrangements.

4. Despite a further decline in requests for fellowships, the discrepancy between the total value of requests and those that the Agency is able to meet has widened further. The amount of help the Agency can give from its own programme has declined further.

5. The Special Fund project that the Agency has been executing in Yugoslavia has been completed, and the project in the Philippines is nearing completion. Two new projects have been assigned to the Agency, one in Central America for the eradication of the Mediterranean fruit fly, and one in Turkey for radiation disinfestation of grain.

6. The long-term programme predicted that the Agency's main contribution to economic welfare would in due course be in the domain of nuclear power, and the subject is increasingly the fulcrum of the Agency's work. The improved economic prospects for nuclear power and their effects on national power plans and on the relations between Government and industry have altered the framework in which the Agency must operate. Its programme is therefore laying more stress on the services it can offer to Member States during the early stages of a nuclear power project, on the long-term economics of fuel supply, on advanced converter and breeder reactors, and on the applications of proven reactor types, particularly to desalting.

7. These developments also affect the Agency's work in health, safety and waste management. The services that the Agency offers for evaluating the safety of sites for nuclear reactors are not yet as widely known or used as they might be, although both industrialized and developing countries have availed themselves of them during the reporting period. Having completed its standard-setting work on most of the main questions of radiation protection, the Agency is devoting more effort to the problem of finding safe and cheap means of disposing of nuclear waste, to providing services which will facilitate international transport of fuel elements and other radioactive materials, and to helping individual Member States to solve local health and safety problems. It has, for instance, begun holding regional study groups, and is expanding its advisory services and other field activities.

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[1] The composition of the Board is given in Annex I to this report.

[2] GC(VIII)/275.

[3] INFCIRC/66.

8. Member States are tending to assign larger responsibilities to the Agency and to regional organizations for handling nuclear science information. Accordingly, the Agency has felt it necessary to give special attention to problems connected with the co-ordination of information activities on an international as well as a regional scale. It has increased the efficiency of its own operations by introducing computer methods and the advanced techniques which go with them.

9. The Special Fund projects mentioned above mark the fact that the agricultural applications of radioisotopes are steadily moving from the laboratory to the field and factory, and from advanced to developing countries. The grain irradiator in Turkey will be the first full-sized plant of this kind outside the industrial countries. The possibilities of using radiation in pest control have been much increased by recent demonstration that the sterile male technique can be used against a far wider range of insects.

10. The most important application of isotopes is in the field of medicine, particularly in the developing countries. The growing interest in this specialization is demonstrated by the steadily and rapidly increasing number of new centres for nuclear medicine which are now being built or planned, particularly in industrialized nations. In the interests of co-ordination the Agency is concentrating on the physical and technical aspects of the subject.

11. Work has also been started in the field of sterilization of pharmaceutical and medical products, and the Agency s activities in radiation biology are also increasing.

12. The application of nuclear science to hydrology has received much stimulus from the International Hydrological Decade and from several Special Fund water resources projects.

13. In the industrial uses of isotopes and radiation the Agency s programme is moving from general surveys to field work, and especially to training. An effort is being made to promote co-operation between atomic energy commissions and industry in various developing countries.

14. Progress has been made during the last year towards the goal of a full-scale exchange of nuclear data between the main data-producing centres in Eastern and Western Europe and North America, and between outlying centres in other areas. The success of this endeavour will require the full support of the Governments and regional centres concerned.

15. The Board also invites the Conference's attention to the following reports on certain parts of the Agency's work:

(a) Review of the Technical Assistance provided by the Agency in 1965; [4] and

(b) IAEA Laboratory Activities - Third Annual Report. [5]

(b) Other developments

16. During the reporting period the membership of the Agency increased from 92 to 96, the new Members being Jamaica, Jordan, Kenya and Panama.

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[4] GC(X)/INF/87.

[5] Technical Reports Series No. 55.

17. In September 1965 the Board made a communication to the Conference in relation to a proposal for the amendment of Article VI.A.2 of the Statute which the Democratic Republic of the Congo had put forward the previous June.[6] As foreshadowed in that communication, the Board reverted to the subject in February 1966, when a further consensus was achieved which is recorded in the following terms:

> The Board took note of the proposal of the Democratic Republic of the Congo for the amendment of Article VI.A.2 of the Statute, and considered that the matter raised therein should be held in abeyance until such time as it might be felt appropriate to undertake a further review of the issues involved; it also noted that some Members had expressed the view that the proposal might be considered at the time that the General Conference might decide to undertake a general review of the provisions of the Statute.

18. At the request of the Preparatory Committee for the Denuclearization of Latin America, the Secretariat has given its observations on certain aspects of a draft treaty which might provide for the application of Agency safeguards as part of the machinery for denuclearizing Latin America.

19. The Conference will recall that in September 1965 it referred to the Board a proposal for the introduction of biennial budgeting.[7] The Board took this proposal up at its meetings last February, when it was recognized that it would be impossible to adopt complete biennial budgeting without amending certain statutory provisions.[8] The Board was nevertheless of the opinion that it would be perfectly practicable to go some way towards preparing two-year budgets for the Agency without making any change in the Statute; and it has indeed already made a start in this direction by including in the introduction to the budget estimates for 1967 preliminary indications of the expenditures that it at present foresees will be called for in 1968.[9]

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[6] GC(IX)/309, para. 2; the proposal itself is reproduced in document GC(IX)/305, para. 1.

[7] By Resolution GC(IX)/RES/196.

[8] Article XIV.A provides for an annual budget, which the Conference approves pursuant to Article V.E.5.

[9] GC(X)/333, paras. 2 and 3.

I. TECHNICAL ASSISTANCE AND TRAINING

(a) General

20. As indicated in paragraph 15 above, a detailed report on the technical assistance provided by the Agency in 1965 is being submitted separately. The present chapter is intended to show what has been done towards accomplishing the objectives which the Agency set itself in its Programme for 1965-66. [10]

21. Since the concept of integrated country programming was introduced there has been better co-ordination between the different programmes through which the Agency's technical assistance is given. A more direct relationship now exists between the various forms of assistance and the projects in a given country's programme. Not all countries have been able to adapt their requests to the new system of integration which requires more advanced planning, but most have taken advantage of it to submit proposals in which the elements of assistance are rationally related to specific projects within their programmes.

(b) Technical assistance

22. In 1965 requests from Member States did not reach the amount expected in the Programme for 1965-66, but in 1966 they came very close to the figure predicted. On the other hand, the funds approved for each of these years were less than estimated in the Programme, so that the gap between requests and assistance actually provided widened. The difference is in fact still larger because only 65% of the allocation for 1965 and 62.5% of the allocation for 1966 is expected to be available. The following table shows the trend in requests and approved allocations.

Table I

Year	Value of projects	
	Requested $	Approved $
1959	690 000	619 400
1960	1 150 000	599 200
1961	1 277 600	513 100
1962	1 530 000	757 600
1963	1 750 000	856 700
1964	2 650 000	807 000
1965	1 990 400	874 000 a/
1966	3 033 500	901 600 b/

a/ 65% expected to be available.

b/ 62.5% expected to be available.

23. During 1965 the combined Agency/EPTA programmes provided 573 man-months of technical assistance experts' services, of which 336 man-months (59%) were under the Agency's regular programme. For 1966 the approved programmes include 857 man-months of experts' services, of which 334 (39%) are under the Agency s programme. This reflects the fact that EPTA programmes always yield a higher proportion of projects during the second year of each biennium.

[10] GC(VIII)/275, paras. 8 to 25.

24. Under the Programme for 1965-66 a sum of $949 452 was provided for the equipment requirements of the combined Agency/EPTA programmes. The funds available under EPTA for the equipment component of projects amounted to $140 190 in 1965 and $164 862 in 1966 - on average 53% more than expected.

25. As provided in the Programme, five one-man technical assistance missions have visited 35 countries to discuss current projects and future assistance - under EPTA for 1967-68 and from the Agency's own resources in 1966 and 1967. These missions discussed not only experts and equipment but also regional and national training courses, fellowships, visiting professors and regional projects.

(c) Training

26. Despite the growth of the Agency's membership, the number of nominations for fellowships has gradually declined since the peak years of 1960 and 1961 as will be seen from the table below. It is believed that three factors are chiefly responsible for this trend: Member States have become aware of the number of fellowships that the Agency is able to award each year and have tailored their requests accordingly; there are better educational and training facilities in some developing countries and advanced training is often available locally; and finally, many developing countries badly need scientists at home to carry out their expanding atomic energy programmes and cannot spare them for training abroad.

Table II

Year	Nominations received	Awards granted
1958	287	161
1959	577	296
1960	649	385
1961	648	295
1962	588	384
1963	580	295
1964	565	341
1965	550	271

These figures include Type I and II and EPTA fellowships. An average of 55% of candidates have received fellowships since the beginning of this programme in 1958.

27. During the period covered by the report, two scientists from two countries started their training under research grants, and ten (two of them under EPTA) from six countries started their scientific visits.

28. Listed below are the ten international or regional training courses that were organized in eight different countries, and attended by 141 foreign trainees in the period under review. Five of these courses were financed under EPTA.

Table III

Date	Title	Country
1965		
19 Jul to 11 Sep	Advanced training course on radioisotopes in animal science and veterinary medicine[a]	United States of America
25 Jul to 19 Aug	Inter-regional course on radiation protection in industry[b]	Denmark
4 Sep to 28 Oct	Regional training course on general applications of radioisotopes[c]	United Arab Republic (Cairo Centre)
4 Oct to 15 Oct	Inter-regional advanced training seminar on radioactive waste management[c]	Japan
4 Oct to 26 Nov	International training course on the use of radioisotopes in entomology[a]	United States of America
4 Oct to 4 Mar	Advanced international training course on the physics of radiotherapy	United Kingdom
11 Oct to 3 Dec	Regional training course on the application of radioactive isotopes in soil-plant relations[a] [c]	Colombia
8 Nov to 17 Dec	International training course on surveys for radionuclides in foods[a] [d]	Austria
1966		
17 Jan to 12 Feb	Inter-regional advanced training school on applications of radioisotopes[c]	Thailand
16 Apr to 23 Jun	Training course on medical applications of radioisotopes[c]	United Arab Republic (Cairo Centre)

a/ Co-sponsored by FAO.

b/ Co-sponsored by ILO.

c/ Financed under EPTA.

d/ Co-sponsored by WHO.

29. The Board has examined the general question of the financial support the Agency should give to centres for training and research, and has formulated certain guiding principles to be applied to requests for this kind of assistance.

30. The Agency has continued to support the activities of the Middle Eastern Regional Radioisotope Centre for the Arab Countries in Cairo. Two training courses, mentioned in paragraph 28 above, were held at the Centre and 11 fellowships were awarded to candidates from six countries. The Director General has extended the Agency's participation in the Centre for two years.

31. Up to the end of 1965 the Agency had assigned 165 (34 thereof in 1965) visiting professors to developing countries; their services were financed from Agency funds and under EPTA.

32. One of the two mobile radioisotope laboratories was sent to Ghana, where it served from April to August 1965 for training a total of 89 persons in Accra, Kumasi and Cape Coast. It was then moved to the Agency s Laboratory at Seibersdorf where it will be used for research. The other mobile laboratory was moved from Rio de Janeiro to San José, in March 1966, where it is to be used for the Special Fund project on eradication of the Mediterranean fruit fly in Central America. Both units have thus been withdrawn from their original use after having provided training to about 1500 students in Africa, Europe, the Far East and Latin America. [11]

(d) Special Fund

33. The Agency acts as Executing Agency for four Special Fund projects. [12] Details of the duration, total cost and Special Fund contribution to each project are given in the following table.

Table IV

Country or region	Duration	Total cost of project $	Special Fund contribution $
1. Yugoslavia			
Nuclear research and training in agriculture	36 months (beginning in April 1963)	2 477 200	613 200
2. Philippines			
Pre-investment study on power, including nuclear power, in Luzon	27 months (beginning in February 1964)	700 500	477 500
3. Central America			
Eradication of the Mediterranean fruit fly	36 months (beginning in September 1965)	1 386 400	870 200
4. Turkey			
Pilot project for radiation disinfestation of grain	36 months	1 549 500	564 500

[11] For a report on the use of the Agency's two mobile radioisotope laboratories during the period 1958-65, see document INFCIRC/81.

[12] Further information on each project is given in the technical chapters in paragraphs 112, 47, 97 and 121 respectively.

II. NUCLEAR POWER AND REACTORS

(a) General

34. Nuclear power stations are rapidly becoming commodities to be bought and sold like other items of trade. Few nations encompass the range of techniques needed to design and construct a new type or a new plant; fewer still are able to produce all the necessary ancillary equipment such as turbines, alternators and pressure vessels. The usual commercial arrangement is thus likely to be the "turnkey contract" or "package deal", involving probably a standard model of plant.

35. The long-term plan foresees that in due course the Agency will make its largest contribution to the economic welfare by its work in nuclear power. The Agency remains exceptionally well-placed to offer the technically advanced countries a quick and effective means of exchanging information - through scientific meetings, by serving as a clearing-house for information, by highly specialized panels etc. Developing countries and countries at the intermediate stage of development are likely to turn increasingly to the Agency for other help as well: for economic and power surveys, for help in choosing, siting and assessing reactors, and for training of scientists, engineers and operating staff. Co-operative projects can be arranged by the Agency; these make for more efficient use of available resources.

36. The demand is likely to be particularly strong for engineers and technicians. In some countries, as a temporary measure, scientists may have to share the load while engineers are being trained The Agency could help by arranging to train engineers and technicians in on-the-job assignments elsewhere.

37. A fully-developed economy requires a bridge of applied science between its "pure" science and industry. In many countries where applied science is still lacking, basic research in atomic energy will have little immediate relevance to the introduction of nuclear power. Its indirect contribution will nevertheless be of much value - in forming a wide group of persons who have some familiarity with atomic energy principles, and a small highly-qualified group to train the cadres of the future - and generally in starting to form the applied science bridge. Hence the aid the Agency gives to research reactor programmes must not only be judged by the volume of research it stimulates but also by the indirect benefits it confers on nuclear technology and on science in general.

(b) The economics of nuclear power

38. The reductions in the cost of nuclear power announced at the Third International Conference on the Peaceful Uses of Atomic Energy in 1964 have been reflected in the number and value of contracts issued for the construction of nuclear power plants in the course of the year under review. Table V below presents a brief summary of present capital and fuel cost ranges, estimated for several proven reactor types.

Table V

Typical costs for proven reactor types

Nominal plant size - MW(e)	200	500	600-800
Unit capital costs - $/kW[a]			
U-gas-graphite[b]	350-380	230-270	220-250
Enriched U-gas-graphite	-	200-240	180-210
U-D_2O - D_2O[c]	320-400	240-270	-
Enriched U - H_2O - H_2O[d]	200-300	130-200	110-140
Fuel costs - mills/kWh			
U-gas-graphite	1.6[e]-2.1	1.3[e]-1.8	-
Enriched U-gas-graphite	-	1.5-1.7	1.5-1.7
U-D_2O - D_2O	0.9-1.2	0.6[f]-0.8	-
Enriched U - H_2O - H_2O	2.2-2.4	2.0-2.2[g]	1.8-2.0

a/ Capital costs are total plant costs, including customer cost, interest during construction, etc. Plant uprating was not assumed.

b/ Typical natural-uranium-fuelled, gas-cooled, graphite-moderated plants.

c/ Typical natural-uranium-fuelled, heavy-water-moderated and cooled plants.

d/ Typical slightly enriched uranium, light-water-moderated and cooled plants.

e/ Based on an irradiation level of 3500 MWd/MTU, 80% load factor, fuel element cost at $40/kgU ($8/lb U_3O_8) and $32/kgU ($5/lb U_3O_8).

f/ Based on an irradiation level of 10 500 MWd/MTU, an average load factor of 80% and fuel element costs of $47/kgU.

g/ Based on an irradiation level of 22 000-24 000 MWd/MTU, an average load factor of 80%, the United States Atomic Energy Commission schedule of charges and $10/g ^{239}Pu-^{241}Pu or toll processed $6/lb U_3O_8 and $9/g ^{239}Pu-^{241}Pu, and chemical processing cost of $32/kgU.

39. Declining costs, and the excellent operational record of power reactors already commissioned [13], have led several countries to expand their plans for nuclear power. The expected proportion of nuclear power to total capacity has grown correspondingly. Estimates of additions to nuclear and total plant capacity in the years ahead are shown in Table VI, while Table VII and figure 1 show expected cumulative growth of nuclear capacity and total capacity from 1965 to 1980. It will be seen that by 1980 about 9% of total capacity is expected to be nuclear.

[13] A list of nuclear power stations in operation and under construction in Member States is given in Annex II.

Table VI

Estimated additions to electric power plant capacity during the period 1965-79[a/]

Country or region	1965-69[b/]			1970-74[b/]			1975-79[b/]		
	Total additional electric power MW(e)	Nuclear power component MW(e)	%	Total additional electric power MW(e)	Nuclear power component MW(e)	%	Total additional electric power MW(e)	Nuclear power component MW(e)	%
Canada	12 000	700	6	13 000	1 900	15	15 000-20 000	4 300	25
France	9 000	1 660	18.5	12 300	3 300	27	15 000	9 000	60
India	14 000	1 200	9	14 000	1 800	13	22 000	7 000	32
Japan	17 000	1 000	6	22 000	2 000	9	25 000	3 000-5 000	16
Pakistan	2 000	300	15	4 000	800	20	5 400	1 400	26
Union of Soviet Socialist Republics	~90 000	1 200	~1	~155 000	several 1 000	...	~220 000	several 10 000	...
United Kingdom	~28 000	~4 000	~14	~30 000	~7 000	~23	~35 000	~23 000	~66
United States	~75 000	~5 800	~8	~80 000	~23 000	~28	~130 000	~40 000	~31
Belgium; Germany, Federal Republic of; Italy; Luxembourg; Netherlands	~19 000	~1 440	~7.5	~32 700	~9 700	~30	~47 000	~14 000	~30
Other European countries	~42 500	~1 200	~2.8	~60 000	~2 800	~5	~85 000	~7 000	~8
Others	~34 000			~48 000	~2 400	~5	~80 000	~5 500	~7
TOTAL	~340 000	18 500	5.5	~470 000	~60 000	~13	~680 000	~120 000	18

a/ These estimates are based on data from the Third Geneva Conference and on additional information subsequently made available to the Agency.

b/ Complete five-year periods are considered, e.g. 1 January 1965 to 31 December 1969 and so on.

Table VII

Estimated cumulative electric power plant capacity 1965-80[a/]

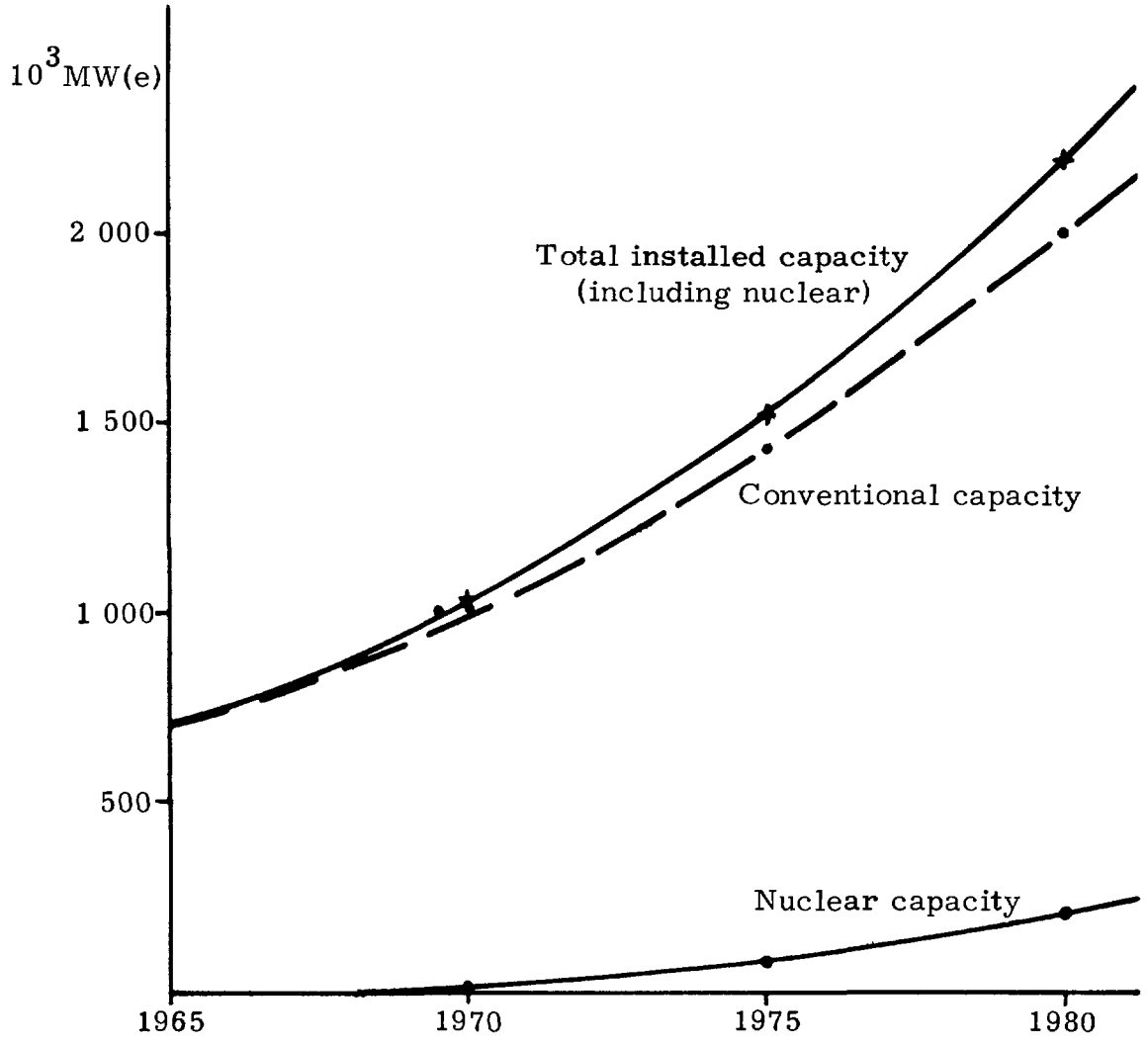
Country or region	1965[b/]			1970[b/]			1975[b/]			1980[b/]		
	Total installed capacity 10^3MW(e)	Nuclear power component 10^3MW(e)	%	Total installed capacity 10^3MW(e)	Nuclear power component 10^3MW(e)	%	Total installed capacity 10^3MW(e)	Nuclear power component 10^3MW(e)	%	Total installed capacity 10^3MW(e)	Nuclear power component 10^3MW(e)	%
Canada	25	0.020	0.08	37	0.720	1.9	50	2.6	5	65-70	~6.9	~10
France	24.5	0.340	1.4	33.5	2.0	6	~46	~5.3	11.5	~61	~14	23
India	10	-	-	24	1.2	5	~38	~3	8	~60	~10	~17
Japan	36	0.012	0.03	53	1.0	1.9	~75	~3	4	~100	~7	7
Pakistan	1.6	-	-	3.6	0.3	8.3	7.6	1.1	14.5	~13	~2.5	~19
Union of Soviet Socialist Republics	104	0.9	0.87	~195	2 1	1.1	~350	several	...	~570	several 10	...
United Kingdom	42	1.3	3.1	~70	5.3	7.6	~100	~12	12	~135	~35	26
United States	240	1.0	0.4	315	6.8	2.2	395	~30	7.5	525	~70	13
Belgium; Germany, Federal Republic of, Italy; Luxembourg, Netherlands	68	0.560	0.8	86.5	2.0	2.3	119	11.7	10	166	26	~16
Other European countries	87.5	0.010	0.01	~130	1.2	0.8	~190	~4	~2	~275	~11	~4
Others	63	-	-	~95			~145	~2.5	~1.7	~220	~8	3.6
TOTAL	700	4.2	0.6	~1040	22.6	2.2	~1510	~80	5.3	~2200	~200	~9

a/ These estimates are based on data from the Third Geneva Conference and on additional information subsequently made available to the Agency.

b/ As of 1 January.

Figure 1

Estimated total electric power and nuclear
power generating capacity
1965-1980



40. The growth of the nuclear industry affects the three main activities of the Agency concerned with the economics of power, namely: collecting cost data; developing methods of comparing costs; and giving help to individual countries to make economic evaluations of the role of nuclear power in their energy supply.

41. Estimates of the capital cost of power reactors are now available, sometimes in the form of price lists, and the part an international organization can play in collecting and disseminating such data has accordingly been somewhat reduced. On the other hand it has become necessary to make a much more detailed analysis of long-term trends in fuel costs, and to obtain more information about the world s resources of fissile and fertile materials. The Agency has therefore joined ENEA in a continuing study of world uranium and thorium resources, and of the extent to which various reactor types are likely to deplete them.

42. Although reactor cost data multiply, it becomes increasingly clear that estimates and comparisons between nuclear and conventional stations are dependable only in the country and power system in which the plants are to operate. It has therefore become important to improve methods of comparing costs between different countries and of making evaluations in the developing countries themselves. The Agency will publish a survey of methods of analysing the cost of nuclear power plants within a given power system.

43. With the help of a panel held in April 1966, the Agency is also preparing a report on costing procedures for nuclear desalting schemes.

44. Assistance in economic evaluations has been given to Argentina, the Philippines and Turkey.

45. The power mission which visited Turkey in June and July 1965 concluded that, while facilities now under construction will probably be sufficient to meet power requirements until 1974, it will be necessary to add at least 500 MW a year from 1975 onwards. By that time nuclear power will be competitive with conventional thermal stations in Turkey. A detailed system planning study should be started by 1970 to determine the role of nuclear stations in the period 1975-80.

46. In July 1965 Argentina was assisted in reviewing some parts of a feasibility study, being carried out by national experts, for a power reactor in the Buenos Aires littoral area. This study is still under consideration by the national authorities.

47. The Special Fund project in the Philippines [14] has been completed. The first phase showed that the country s energy resources could not meet the expected power requirements and that it would be necessary to import fuel - fossil or nuclear. In the second phase detailed economic comparisons were made between conventional and nuclear plants, and an optimum programme for the Luzon grid was developed.

48. In this study the Agency has tried to develop a suitable method for making an objective analysis of the possible role of nuclear power in a given country. The report on the project, which will be published late in 1966, should be of interest to other developing countries contemplating the use of nuclear power.

(c) Technical aspects of reactor development

49. The following are some of the most important recent technical developments:

(a) The tendency to build even larger light-water reactors, having an output of up to 1000 MW(e);

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[14] See para. 33 and Table IV above, and also document GC(IX)/299, para. 25.

(b) Encouraging initial experience with the superheater fuel elements of nuclear superheat reactors;

(c) The successful development of a large competitive advanced gas-cooled reactor type, on which one Member State will base most of its nuclear power programme in the decade ahead;

(d) The rapid progress in the technology of manufacturing fuel for high-temperature gas-cooled reactors;

(e) The completion of the first full-scale heavy-water natural-uranium nuclear power plant; and

(f) Progress towards the use of other coolants (carbon dioxide, light water and organics) for heavy-water reactors.

50. As proven reactor systems achieve lower production costs and their performance improves, it becomes more difficult to justify large expenditures on new reactor systems unless they promise very substantial advantages. This has led Member States to revise their reactor development programmes in a way that affects some experimental plants and new projects. For instance, work on a nearly completed helium-cooled graphite-moderated enriched-uranium reactor has been stopped; a sodium-cooled graphite-moderated reactor which developed some technical problems after three years of operation may not be restarted.

51. While advanced converter reactors continue to attract much attention in countries which do not expect to build commercial breeder reactors before the early 1980 s, in certain others the tendency is to rely upon improved versions of existing systems in the expectation that commercial breeders will be available in the late 1970 s. As to fast breeder reactors, one Member State with an experimental reactor of 15 MW(e) at full power operation for some years, has decided to construct a 250 MW(e) prototype to be ready in 1971, another is building a 1000 MW(th) plant, and in a third a plant is gradually approaching full-power operation at 60 MW(e).

52. These developments have done much to influence the Agency's own programme. The Agency has been devoting particular attention to developments in breeder reactors because they promise very low fuel cycle costs and the most rational use of available fuel resources. The problems of plutonium technology for fast reactors were reviewed in the proceedings of the panel on plutonium utilization, issued in 1965. [15] A review of fast power reactors was published in 1966, and plans are being made for a symposium on physics and related problems of fast reactors, to be held in 1967.

53. Liquid metals are excellent media for transferring heat and have, therefore, special advantages in fast reactors which generate a great deal of power in small cores. However, metals such as sodium corrode their containers at high temperatures. To discuss this and other similar problems the Agency is organizing a symposium on alkaline metal coolants: corrosion studies and system operating experience, to be held late in 1966; a review of recent developments in liquid metal heat transfer has already been published.

54. Organic liquids, already used as coolants and moderators in experimental reactors, are now attracting interest as coolants for large heavy-water reactors for power generation and desalting. In May 1966 an Agency panel reviewed various aspects of the use of organics in power reactors.

55. The integrity and reliability of pressure vessels are vital in determining the safety and lifetime of nuclear power stations using them. The Agency has been surveying national regulations and codes governing the inspection of pressure vessels. A panel on recurring

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[15] Use of Plutonium for Power Production - Technical Reports Series No. 49.

inspection of nuclear pressure vessels will be held in the Czechoslovak Socialist Republic in October 1966, with the object of achieving greater uniformity in international practice and of formulating guidelines for the conduct of such inspections.

56. In accordance with arrangements made previously with the Governments of Canada, the United Kingdom and the United States, the Secretariat continues to follow the development of selected power reactor projects in those countries with a view to publishing brief reports on the design, construction, operating experience, safety and cost of the reactor. During the past year Sweden offered to give the Agency similar information about a Swedish reactor project.

57. The first edition of the Reactor Card Index, covering 800 reactors, has been completed. [16] The Index will be kept up to date and supplements issued at suitable intervals.

58. The sixth volume of the Directory of Nuclear Reactors is expected to be issued in July 1966, and work has started on the seventh volume, devoted to power reactors.

(d) Research reactors

59. During the reporting period, seven new research reactors of more than 10 kW thermal output were brought into operation in Canada, the Federal Republic of Germany, Pakistan, the United States and Yugoslavia. The reactor in Venezuela was re-started. The total number of such research reactors in operation in 44 Member States is now approximately 190. The growth in the number of research reactors over the past decade is shown in figure 2 below. Seventy-four of these reactors are located in countries other than Canada, France, the Soviet Union, the United Kingdom and the United States; and 20 are in developing countries.

60. In technically advanced countries there is a marked trend towards greater specialization in new research reactors. For example, one Member State has built a reactor chiefly to produce transcalifornium isotopes and a second reactor for high-intensity neutron beam research in nuclear and solid-state physics; another Member State has built a reactor especially for research on organic coolants. This trend, noticeable even in the programmes of small research reactors, is helped along by the development of experimental techniques in various highly specialized fields of research.

61. The Agency's study group meetings during the year concentrated on one or two main topics. The meeting in Istanbul in November 1965 was devoted chiefly to reviewing recent developments in radiation techniques; the meeting in December 1965 in Caracas to problems of operation and maintenance of research reactors; and the Lucas Heights' (Australia) meeting in March 1966, to topics in solid-state physics and the chemistry of irradiated materials.

62. Experience has indicated that by choosing a few topics to be discussed informally by a relatively small group of scientists, it is possible to arrange a valuable and high-level exchange of information and professional contact between the scientists of a region, and to identify common problems and objectives.

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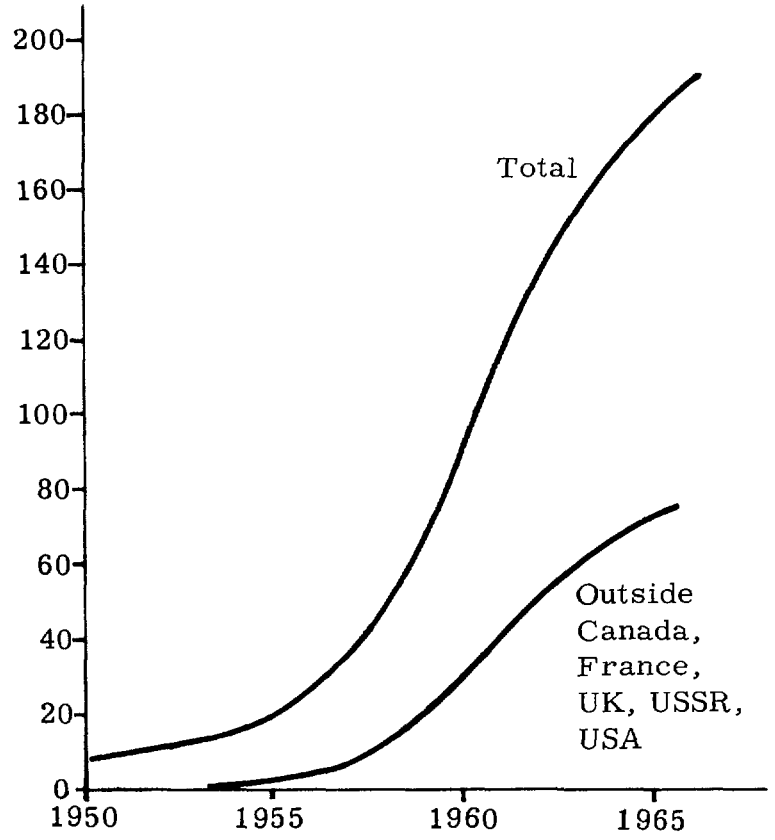
[16] Publication STI/PUB/85.

Figure 2

Number of research reactors
in operation



63. The Agency has also continued to stimulate the exchange of information and co-operation between reactor centres by:

(a) Holding specialized panels such as the one on in-pile neutron fluence measurements in October 1965; which resulted in the preparation of a manual on neutron fluence measurement techniques, and in a study of methods for distributing calibrated isotopic sources, gamma sources, activated standard foils, and various fluence detector materials;

(b) Promoting co-operative research programmes such as the NORA and NPY projects in reactor physics research [17], and the IPA project in solid-state physics research using neutron diffraction methods [18]; and

(c) Organizing special summer schools and seminars, such as the NPY seminar, mentioned in paragraph 65 below, and the NORA seminar in reactor noise which was held at Kjeller in March 1966 and attended by 25 scientists.

64. The NORA project has recently been concerned with the study of a 3.4% enriched uranium dioxide in a light-water moderator. The neutron flux distributions and other important parameters were measured and the results compared with values calculated by computer codes in standard use or newly developed. This permits the theoretical methods to be checked and improved.

65. The NPY programme comprises nine tasks in reactor physics, and progress is being made through close co-operation. Neutron thermalization, also important to NORA, was the subject of an NPY seminar (Warsaw, December 1965) which is to yield a monograph on the subject. This seminar was attended by 28 scientists from the participating countries.

66. The IPA project has been very successful in its field of neutron diffraction and several crystal structures have been examined. A second spectrometer is ready for use. Other Member States in the region are expressing interest in joining the project.

67. The French Government's offer of a liquid-nitrogen irradiation loop has enabled the Agency to explore the possibility of a research project in radiation damage studies at an appropriate reactor centre.

(e) Reactor safety

68. A symposium on criticality control of fissile materials which was held at Stockholm in November 1965, discussed basic criticality data, advanced methods of calculating criticality in complex geometrical assemblies, and the best means of ensuring plant safety. These questions are particularly important for the design and operation of fuel processing plants.

69. There is now a tendency to locate power reactors closer to load centres, and to build bigger plants that entail larger inventories of fission products. The proximity of plant and inventory to population centres means that much more care must be taken in relating station design to sites under consideration. The Agency arranged for missions to examine possible sites for nuclear power or desalting plants in Tunisia, in September 1965, and China, in March 1966.

70. The Secretariat has made or arranged for safety evaluations of projects involving the transfer of fuel under Agency auspices to Yugoslavia.

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[17] GC(IX)/299, paras. 44 and 45 respectively.

[18] Ibid., para. 40.

71. It has also started work, in collaboration with IMCO and the International Association of Ports and Harbours, on methods of evaluating harbours and narrow waters for the safe passage or entry of nuclear merchant vessels. It is hoped that international agreement can eventually be reached on the methods to be used.

(f) Nuclear fuels and equipment

72. Nuclear fuel cycle costs constitute a large fraction of the total generating costs of a nuclear power plant, which means that there is considerable economic advantage to be gained by improving fuel technology and burn-up, and by reducing fabrication and reprocessing charges. The progress achieved in increasing fuel burn-up is shown by the fact that in water reactors average burn-ups of 27 000 MWd/t (megawatt days per ton) are now being guaranteed by fuel suppliers while a few years ago the comparable figure was about 10 000 MWd/t. In advanced gas-cooled reactors the use of stainless-steel-clad enriched uranium fuel and on-load refuelling means an optimum average burn-up of 18 000 to 20 000 MWd/t, for which comparable guarantees may be given by the suppliers. In high-temperature gas-cooled reactors using coated particles, burn-ups of more than 100 000 MWd/t appear to be technically feasible. Fast reactor fuel has been irradiated to 8% of heavy atoms (approximately 60 000 MWd/t maximum), and it is considered that targets of 45 000 MWd/t (average) and 55 000 MWd/t (maximum) are achievable with current designs. This progress reflects advances in fuel fabrication technology, which have already brought down the cost of fabrication and promise further savings. The development of carbide fuels is continuing, as is work on beryllium as a moderator in gas-cooled reactors.

73. Non-aqueous reprocessing of fuel may offer several advantages over the present aqueous system, e.g. processing of irradiated fuels after a very short cooling period, avoidance or simplification of intricate chemical processes, and production of concentrated solid wastes without the usual intermediate stages.

74. Growing nuclear power programmes may provide the economic incentive to exploit low-grade uranium ores by the advanced techniques now being developed. An Agency panel on the processing of low-grade uranium ores, held in June 1966, reviewed the latest recovery techniques and the economies they could bring.

75. Member States are expected to seek more help from the Agency in obtaining nuclear fuels and developing their own nuclear fuel resources. In December 1965 Tunisia was advised on the recovery of uranium from its phosphate ores.

76. During the period under review the Board took the action necessary to enable the Agency to assist Member States by supplying the following:

(a) To Finland, about 740 g of uranium enriched to about 20% in the isotope uranium-235, to be contained in 20 fuel elements for use in the FiR-1 Triga Mark II training and research reactor at the Institute of Technology at Otaniemi;

(b) To India, 80 g of plutonium for a 5-curie plutonium-beryllium neutron source for testing the ionization chambers being made for the Rajasthan Atomic Power Project;

(c) To Mexico, about 2530 kg of natural uranium fabricated into fuel elements and a 5-curie plutonium-beryllium neutron source for a sub-critical training assembly at the National Polytechnic Institute of Mexico in Mexico City; and

(d) To Uruguay, a research reactor and 16 050 g of uranium containing 3183 g of uranium-235.

77. From the annual United States' grant of special fissionable materials up to a value of $50 000, the Board approved a transfer of material to the value of approximately $40 000 for the reactor project in Uruguay, and about $10 000 for a reactor project in Argentina. The Government of the United States has allocated the material accordingly.

(g) Desalting

78. Member States are continuing to strengthen their desalting programmes. In August 1965 the United States authorized $200 million for the period July 1966 to July 1971; the Soviet Union is building a large prototype nuclear desalting plant; and the United Kingdom has given its Atomic Energy Authority responsibility for research and development into methods of desalting for civil use.

79. That there is world-wide interest in nuclear desalting was demonstrated by the participation of more than 60 countries in the First International Symposium on Desalination, held in Washington in October 1965. The Secretariat presented a paper at one of the sessions.

80. About 90 conventional desalting plants are in operation, the largest with a capacity of 6400 m^3 of water per day. The cost of water from these plants is at least 25 cents/m^3. A feasibility study for a very large nuclear plant in Southern California (having a capacity of 568 000 m^3 of water per day and an electrical output of 1600 MW) has indicated, on favourable assumptions, a cost of 6 cents/m^3. For wide-scale use in agriculture the cost of water should be of the order of one to two cents per m^3. This can be achieved only if nuclear fuel cycle costs and the capital cost of reactors as well as desalters are substantially lowered.

81. In the short term it seems that the multi-stage flash evaporator desalter, coupled with a nuclear reactor, may be the best means of obtaining large quantities of fresh water at a reasonable cost, i.e. cheap enough for general domestic and industrial use. The technology of the nuclear component is well advanced, but more work is needed to develop large-scale economic desalters; in other words, there must be more development and engineering work on the conventional aspects of desalting.

82. Construction of the first nuclear desalting plant using a fast breeder reactor as a heat source is in progress at Shevchenko on the Caspian Sea, in the Soviet Union. It will have a capacity of 94 900 m^3/d and 150 MW(e). Other nuclear desalting plants are under consideration in Israel, Mexico and the United States.

83. In accordance with General Conference Resolution GC(IX)/RES/197 on the application of nuclear energy to desalting, the Secretariat is extending its work on the subject. The Agency has provided the chairman and secretary of the joint Agency/Mexico/United States Study Group, which is examining the economic and technical feasibility of a dual-purpose plant to supply power and water to part of the States of California and Arizona in the United States and Baja California and Sonora in Mexico. [19] The Study Group met in December 1965 and April 1966 and is investigating the water and power resources and needs of the area, the nuclear and desalting technology that will be needed for an appropriate plant, and possible sites for the plant.

84. The Agency has continued to take part as an observer in meetings of the Joint Board of the Israel/United States Nuclear Desalting Project. In February 1966 the Joint Board approved a report on an engineering feasibility and economic study for a dual-purpose plant which concluded that a plant with a capacity of 379 000 m^3/d and an electrical output of 200 MW(e) could supply steam more economically than a fossil-fired source.

85. During March and April 1966 an Agency/United Nations mission visited Chile and Peru to survey the prospects of using nuclear energy for power and desalting.

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[19] INFCIRC/75.

86. In April 1966 the Agency convened a panel on costing procedures for nuclear desalination, to help prepare a publication on the subject which could be useful in evaluating the relative economics of alternative desalting projects.

87. The Agency has published the proceedings of its fifth panel on the use of nuclear energy in water desalination, together with a review of the work of the panels held in September 1963 and April 1964. [20]

[20] Publication STI/DOC/10/51.

III. ISOTOPES AND RADIATION SOURCES

(a) Agriculture

(i) General

88. The Joint FAO/IAEA Division of Atomic Energy in Agriculture was established at the Agency's Headquarters on 1 October 1964. [21] This report describes the first full year of its activities. The experience of the Joint Division during the trial period which ended on 31 December 1965 was satisfactory. The operation was reviewed by both organizations in April 1966.

89. A large part of the scientific programme of the Joint Division is carried out through research contracts or cost-free research agreements. Table VIII below shows the distribution of such projects, by subject matter and by country.

Table VIII

Distribution of agriculture research co-ordinated contracts by programme and by country

Research topic	Countries in which research is being carried out with Agency support
Rice fertilization programme	Burma, Ceylon, China (2), Hungary, India, Italy, Republic of Korea, Madagascar, Pakistan (2), Philippines, Thailand, United Arab Republic
Maize fertilization programme	Argentina, Brazil, Colombia, Ghana, Mexico, Peru, Romania, United Arab Republic
Water use efficiency	Belgium, Iraq, Israel, Kenya, Lebanon, Morocco, Pakistan, United Arab Republic
Entomology; sterile male technique	Belgium, El Salvador, Israel, Republic of Korea, Pakistan, Southern Rhodesia, United Arab Republic
Rice mutation breeding	Ceylon, China, India, Japan, Pakistan, Philippines, Thailand
Production and use of induced mutation in plant breeding	Argentina[a/], France[a/], Federal Republic of Germany (2[a/]), India[a/], Italy (2[a/]), Japan[a/], Norway, Sweden (2[a/]), United States of America (4[a/]), Yugoslavia[a/]

a/ These contracts are "cost-free research co-operation agreements".

(ii) Soil fertility and plant nutrition

90. A rapid increase in the food supplies of the developing countries can best be achieved by a more widespread use of fertilizers. In many countries, however, the cost of fertilizer discourages the farmer from using it, and fertilizer supplies may be inadequate in any case. The object of the programmes described below is therefore to find means of ensuring that fertilizers applied to the soil are used by the crops as efficiently as possible.

[21] GC(IX)/299, para. 84.

91. The further findings of the rice fertilization programme [22] are that nitrogen is best placed 5 cm below the surface, phosphorus fertilizer on the surface, and that the uptake of phosphorus can be slightly stimulated by mixing it with nitrogen.

92. In the maize fertilization programme it was found that phosphorus uptake can be much increased by mixing it with nitrogen fertilizer. The late application of nitrogen fertilizer (ammonium sulphate) close to tasseling time resulted in a much higher efficiency of nitrogen utilization than from application at planting.

93. The following two symposia were held under this programme:

(a) A symposium on the use of isotopes and radiation in soil-plant nutrition studies (Ankara, June/July 1965). The symposium showed that these techniques can be particularly useful in obtaining more information on the nutrition and fertilization of such food crops as oats, barley, wheat, olives, vines, field and soya beans, as well as rice and maize; and

(b) A symposium on the use of isotopes in weed research (Vienna, October 1965). The meeting reviewed recent progress, and was also designed to show experts in weed research what can be achieved with isotope techniques.

94. To help meet the need for trained technicians in this field, the Agency and FAO held a regional training course on the application of radioisotopes in soil-plant relations, in Bogotá, from 11 November to 3 December 1965. There were 14 participants from eight Latin American countries.

(iii) Irrigation, soil moisture and structure

95. Eight contractors are now taking part in the co-ordinated programme on water use efficiency studies, which will support the use of neutron moisture meters to study the effectiveness of various methods of using and conserving water. The special advantages of the neutron moisture meter are that it can be used to carry out large numbers of individual measurements of soil moisture at different depths without the digging or other disturbance of the soil that conventional methods entail.

(iv) Radiation entomology

96. This programme has consisted chiefly of developing and promoting the application of the sterile male technique, which has been described in previous reports. One of the main outstanding problems is to find a cheap way of rearing large numbers of the insect to be controlled.

97. Thanks to co-operation between the Agency and the Biological Control Institute of the Citrus Marketing Board of Israel a cheap means of rearing the Mediterranean fruit fly has been found. The Agency's Laboratory has developed techniques for producing several million flies a week and for releasing and dispersing them. This work is being turned to good use in the Special Fund Project for the Eradication of the Mediterranean fruit fly in Central America [23]. A facility is being built where the fly can be produced in large numbers, and surveys have been carried out to determine the best areas for applying the technique.

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[22] See documents GC(VIII)/270, para. 25, and GC(IX)/299, para. 88.

[23] See para. 33 and Table IV above, and also document GC(IX)/299, para. 97.

98. The difficulty of rearing the olive fly in large numbers has been previously reported. More encouraging results have been obtained recently, however, and when the problem is finally resolved a study of the insect's population dynamics can be started.

99. The same problem is also the chief obstacle to further progress in applying the sterile male technique to the tsetse fly. A research contractor is investigating methods of rearing them in the field, and work on laboratory rearing is going on at the Agency's Laboratory in Seibersdorf.

100. The Joint Division has also started work on mass rearing of the tropical ox warble, the codling moth and several other species of fruit fly.

101. The Agency and FAO held an international training course on the use of radioisotopes in entomology, at Florida, United States, from 4 October to 6 November 1965. Twenty entomologists from as many countries took part.

(v) Residues

102. While the level of fission products from fall-out in human diet is still appreciable, it has declined during the reporting period. The Agency and FAO have continued to publish material on the subject and to support the activities of UNSCEAR.

103. A report has been given to UNSCEAR on the levels of natural radioactivity in soil, vegetation and food. This report was required for a study of human radiosensitivity which UNSCEAR is making.

104. A joint FAO/WHO/Agency training course on surveys for radionuclides in food and agriculture was held at the Seibersdorf Laboratory in November/December 1965. Seventeen participants from 13 countries attended.

(vi) Plant breeding and genetics

105. As was reported last year [24], the technique of artificially inducing mutations is now being accepted by plant breeders. Although enormous variability is naturally present in crop plants certain desired traits, such as resistance to some diseases, may have to be induced artificially. A technique that multiplies the rate of mutation is accordingly of great importance. Thus, for example, 60% of all material used in barley breeding in Sweden is of mutant origin.

106. Seven countries are now participating in the Co-ordinated Rice Mutation Programme. At a meeting in Manila in February 1966 it was disclosed that several promising mutant strains of rice have already been produced in China, India and Japan, some of which mature as much as 40 days earlier than the standard variety, while others have improved grain quality, higher yield and increased resistance to disease.

107. Nine countries have tested mutant lines of durum wheat developed in Italy under the FAO Near-East Wheat and Barley Project. An FAO/Agency Advisory Commission visited experimental fields, and the Seibersdorf Laboratory has started work on radiation-induced resistance to important diseases of wheat.

108. The data obtained in the durum wheat trials will be classified so that they can be recorded and analysed by computer. The Joint Division is in fact working out standard procedures for computer recording and analysis of crop research data and agricultural experiments of all kinds.

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[24] GC(IX)/299, para. 92.

109. Preparations have been completed for a co-ordinated programme of research on seed irradiation with neutrons, for which the Agency's Laboratory and the Austrian reactor at Seibersdorf are to be used.

(vii) Animal disease control

110. The second FAO/Agency international training course on the use of isotopes and radiation in animal science and veterinary medicine was held at Cornell University, in the United States, from July to September 1965. Nineteen participants from 19 countries attended.

(viii) The Special Fund Project in Yugoslavia [25]

111. The three-year Special Fund Project for the Application of Nuclear Energy in Agriculture, Veterinary Medicine and Forestry at Zemun, Yugoslavia, was completed in April 1966. Under this project a research station has been built and equipped, Yugoslav personnel have been trained, experts have been provided in various fields, and a research programme of importance to the agricultural economy of the country has been started. Plans have been made for the future work of the institute and for its co-operation with other research organizations and agricultural stations in Yugoslavia. To help carry out these plans the Special Fund is giving further financial support to cover the period April/ December 1966. After that any further support needed will be sought through the normal technical assistance channels.

(b) Food irradiation

(i) General

112. The importance of protecting the world's food supplies from damage caused by insects and microorganisms during harvesting, distribution and storage needs little emphasis. Because of public apprehensions radiation-preserved food had to be tested very rigorously for wholesomeness, but the technique seems to have reached the stage of practical application. The decline in cost of radiation sources promises to make the technique economically feasible, but a final evaluation must await experience with a number of large pilot and industrial plants. The first commercial use - designed to inhibit the sprouting of potatoes - started as late as 1965. The present trend is to use radiation chiefly where it can obtain results beyond the reach of traditional methods.

113. An international symposium on food irradiation, held in June 1966 in Karlsruhe, Federal Republic of Germany, showed that a wide variety of foodstuffs existed with which irradiation could be used for three different purposes: to produce indefinitely stable products; to rid food of organisms that constitute health hazards, and to extend the normal shelf or market life of perishable food products. It showed also that, after much further research, irradiation of food will play a very important role in the life of mankind. It would play this part beside, and in many instances in conjunction with the conventional food treatment methods, such as heat, refrigeration and chemicals.

(ii) Food preservation and processing

114. Practical interest now centres on controlling food-borne diseases and parasites in meat, poultry, egg products, blood, bone and fish meal, and on extending the storage life of fish and marine products as well as certain fruits and vegetables.

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[25] See para. 33 and Table IV above, and also document GC(IX)/299, para. 115.

115. In this connection the main problems are:

(a) To find ways of decreasing the radio-resistance of microorganisms that cause spoilage, so that the required radiation dose can be reduced;

(b) To prevent undesirable changes in irradiated foods; and

(c) To study the ecology, toxin formation and radiation elimination of microorganisms pathogenic in food.

116. A panel on co-ordination of research in radiation sensitization of microorganisms in food preservation (Vienna, July 1965) stressed the need for work on the mechanism of "combined processes", i.e. the use of chemical and/or physical agents to increase the sensitivity of microbes to ionizing radiation; and, conversely, the use of radiation to increase their sensitivity to anti-microbe chemicals or physical factors. There are three research contracts and one research agreement on these topics at present.

117. Three research contracts have been awarded to laboratories in developing countries, mainly for work on the mechanism of radiation-induced changes in tropical fruits. The Agency's Laboratory is also studying tissue changes that take place in horticultural produce irradiated to prolong its storage life.

118. This work is co-ordinated with the joint Austrian Atomic Energy Society/ENEA/Agency International Programme on Irradiation of Fruit and Fruit Juices, which the Agency has supported chiefly by providing a technical adviser and two fellows. [26] The programme is being carried out at the Austrian laboratory at Seibersdorf, and there is close scientific co-operation with the Agency's own laboratories. Most of the support for the programme comes from the Austrian Atomic Energy Society but a number of Member States of OECD have assigned experts to it.

119. Four research contracts and three research agreements are in progress on problems of radiation elimination of microorganisms pathogenic in food, and on the toxins of certain microorganisms.

(iii) Food disinfestation

120. The vast losses caused by insects in grain, dried fruits and vegetables and dried or smoked fish, especially in sub-tropical and tropical countries, have stimulated public interest in radiation control. Before radiation can be commercially used, however, several questions, particularly those related to cost, have to be clarified.

121. In June 1965 the Special Fund decided to establish the first international food irradiation plant - for grain - in Turkey. [27] The plant is also to be used for demonstrations and training, and will be the first facility at which comparative technical and economic evaluations can be carried out with sufficient precision and reliability to show the industrial potential of this technique for other developing countries.

(c) Nuclear medicine and radiation biology

(i) Radiation sensitivity

122. The radiation dose required to inactivate a cell depends on the extent of radiochemical damage and the capacity of the cell to repair it. Damage to blood-forming tissue

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[26] INFCIRC/64.

[27] GC(IX)/299, para. 114.

is a critical factor in the total injury sustained by an irradiated mammal. As the use of radiation in industry and medicine becomes more common, radiation haematology is bound to acquire increasing importance.

123. A panel on effects of various types of ionizing radiation from different sources on haematopoietic tissue, held in Vienna in May 1966, tried to identify the most pressing problems of the subject, and discussed the facts and concepts of normal haemapoiesis and its regulation, the qualitative and quantitative aspects of the effects of conventional radiation sources on haemapoiesis and the comparative reactions of haematopoietic tissue from different animals after irradiation.

124. A panel on genetical aspects of radiosensitivity: mechanisms of repair held in Vienna in April 1966, examined the capacity of the cell to repair damage, a question of obvious importance in radiation therapy, and one which has a direct bearing on five current research contracts.

125. It has been shown that analyses of damage to chromosomes, usually a time-consuming laboratory task, can be done by computer. Large-scale monitoring of individuals exposed to radiation in industrial or chemical work may therefore be possible. An Agency Study Group Meeting considered the problems of the method in May 1966.

126. Biological responses to irradiation are difficult to assess in terms of physical measurements or effects. The Agency is supporting research in several directions - work which is of great practical as well as purely scientific value since it will provide fundamental information for radiation protection guides. Institutes in Canada, Poland, the United Kingdom and Yugoslavia are taking part in a cost-free research programme on the biophysical effects of different types of radiation.

(ii) Radiation toxicology

127. Much more information is still needed on the effects of long-term exposure to the small radiation doses which may result from ingestion of radionuclides - a potential hazard in industrial work.

128. In October 1965 the Agency and WHO organized a panel on dosimetry and toxicity of thorotrast; information has been obtained from persons carrying body burdens of thorotrast as a result of its diagnostic use between 1935 and 1948. The panel compared thorotrast irradiation with other types and recommended that the numerous groups studying thorotrast cases should co-ordinate their work more closely. The Agency described its own laboratory's work on the correlation of lymphocyte chromosome aberrations, a project carried out in co-operation with two departments of the University of Vienna. A first report on this work is now being published. [28]

(iii) Diagnostic and research applications of radioisotopes

129. Laboratories of nuclear medicine are continuing to increase in numbers and size and, with labelled compounds more readily available and equipment more versatile, new methods of diagnosis and research are being found. In tropical and sub-tropical regions the new tools are being brought to bear on diseases that affect large numbers of people, in particular on malnutrition and the disorders it causes; and this work is expected to indicate better ways of using limited food supplies. Demands on the Agency's technical assistance and research support programmes have accordingly increased.

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[28] Fischer, P., Grolob, E., Kunze-Mühl, E., ben Haim, A., Dudley, R.A., Müllner, T., Parr, R.M. and Vetter, H., Chromosome aberrations in peripheral blood cells in man following chronic irradiation from internal deposits of thorotrast.

130. From 17 January to 11 February 1966 the Agency held an advanced training seminar on medical isotope applications, in Bangkok. It was designed for persons, such as heads of radioisotope departments in hospitals, who have been doing isotope work for several years. Twenty students from 11 Asian countries attended.

131. In November 1965 the Directors General of the Agency and WHO sought the advice of a group of consultants about establishing an international centre for nuclear medicine. The group's recommendations, and the views of persons who have first-hand knowledge of the need for improved training in nuclear medicine, are now being studied.

132. Research in the medical uses of isotopes is still mainly devoted to those topics which were given priority by a joint Agency/WHO panel in 1962, but the number of contracts has continued to grow as has the amount of support given by the Agency. The distribution of contracts is shown in Table IX below.

Table IX

Distribution of medical isotope research contracts by subject and by country

Research topic	Countries in which medical isotope research is being done with Agency support
Anaemia	Ceylon, Ecuador, Iraq, Japan, Republic of Korea (2), Lebanon, Nigeria, Romania, South Africa, Turkey (2), United Arab Republic
Goitre	Australia, Austria, Belgium, Bolivia, Bulgaria, Chile, Israel, Lebanon, Spain
Parasitology	Ceylon, Colombia, Japan, Philippines, Portugal, Thailand, Uruguay
Malnutrition	Argentina, Brazil, Chile, Democratic Republic of the Congo, Guatemala, India (2), Israel, Jamaica, Nigeria, Pakistan, Philippines, South Africa

(iv) Applications of radiation sources

133. The Agency has continued its efforts to help overcome the shortage of trained hospital physicists, which is still the main obstacle to the development of sound radiotherapy in most Member States. Apart from providing technical assistance, the Agency held a second international training course on physics applied to radiotherapy, in London, from 4 October 1965 to 4 March 1966. The course was organized in co-operation with the Hospital Physicists' Association of the United Kingdom and was attended by 15 participants from 14 countries.

134. Arrangements were made to supply equipment under the auspices of the Agency for therapy centres in five countries. Details of the equipment offered and supplied during the reporting period are given in Annex V.

135. The Agency has continued to supply radiation data to hospital physicists, in particular on the physical aspects of teletherapy and brachytherapy with radioisotope sources. From November 1963 to January 1966, 1072 requests were received from 17 Member States.

136. There is growing interest in the use of radiation to sterilize surgical and pharmaceutical materials and biological tissues (bone, cartilage, etc.). A panel on the use of ionizing radiation for the sterilization of medical products (Vienna, January 1966) recommended that an international code of practice be established, and suggested that in the meantime the Agency should provide guidance on the subject to Member States.

(d) Hydrology

137. Last year the General Conference was informed of the part the Agency is taking in the International Hydrological Decade (IHD) [29]. Interest in the use of isotope techniques to study hydrological problems - especially problems of large areas - has continued to grow.

138. The Secretariat has obtained further hydrological data about losses from a large lake in the Antalya region, Turkey, and about Lake Chala in Kenya, which will be useful in planning irrigation schemes dependent upon these lakes. [30]

139. Two new ground-water projects have been started in collaboration with FAO. The first is in Jamaica, and preliminary findings indicate that there are two main types of water in an area studied. The second project, in Jordan, is the investigation of a deep-lying sandstone aquifer.

140. Other projects are being carried out within the framework of IHD. Studies in the Vienna Basin have shown that local or lateral water contributes more than was previously realized to the main aquifer system. The Agency, the University of Pisa and the Hydrological Research Institute in Prague are making a joint study of the snow hydrology of a mountain basin in the Czechoslovak Socialist Republic.

141. The Agency was also assigned responsibility, under the IHD programme, for a working group which met in March 1966 to discuss the use of nuclear techniques to determine the water content of saturated and unsaturated zones.

142. The Agency/WMO world-wide precipitation survey has been modified to reduce the number of precipitation sampling stations and to include sampling of ocean surface water.

143. A co-ordinated programme has been started to test the value of isotope techniques in selected important hydrological settings. For example, the Atomic Energy Research Institute of the Republic of Korea has been awarded a research contract so that it can make tests in the porous volcanic terrain typical of many Pacific islands.

144. In October 1965 a working group on isotope techniques in hydrology met at Grenoble, reviewed the latest results obtained by a number of co-operating hydrological laboratories, and recommended future lines of work.

(e) Industry

145. The Agency's programme consists in publicizing the well-established industrial uses of radioisotopes, and in developing new techniques to meet special needs - by supporting research and helping to co-ordinate the work of other laboratories.

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[29] GC(IX)/299, para. 116.

[30] Ibid., paras. 120 and 122.

146. A panel on the use of radioisotopes in the development of natural resources (Cracow, Poland, October 1965) discussed the physical principles of radioisotopes as sealed sources and tracers, and their practical applications as a means of evaluating, developing and processing mineral resources. It suggested several ways in which the Agency could promote the use of these techniques, especially in the developing countries. It also recommended that the Agency should try to bring about some standardization of the terms and definitions used in connection with neutron moisture meters, and, with the help of consultants, the Secretariat has accordingly drawn up a list of standard definitions which users and manufacturers are being asked to adopt.

147. A symposium on radioisotope instruments in industry and geophysics (Warsaw, October 1965) reviewed the use of radioisotope instruments to measure properties such as chemical composition, thickness, density, porosity, level and composition.

148. A group of consultants met in April 1966 to discuss the publication, by the Agency, of bibliographies dealing with industrial applications of radioisotopes.

IV. HEALTH, SAFETY AND WASTE MANAGEMENT

149. Though safety standards still have to be established in a few particular fields, recommendations and studies dealing with the main general problems of radiation protection and waste management have now been made by the Agency and are being supplemented by specialized detailed manuals.

150. More effort must be made in two directions: improving existing techniques, particularly with regard to waste treatment processes and reducing of their costs; and helping Member States to apply available information to their individual problems.

151. The main developments of the programme have been: meetings for the co-ordination of research, increased emphasis on the economics of waste management, the growth of field activities such as regional study groups and training, and the growth of advisory services.

152. In September 1965 the Board approved the revised Basic Safety Standards for Radiation Protection [31]. One of the main new features is a recommendation that maximum permissible doses be set by limiting the quarterly radiation intake of exposed persons, rather than by limiting the concentration of radioactivity in the air and water in their environment. This makes it easier for national authorities to give due weight to variable local conditions, such as food and water consumption.

153. In March 1966 ECOSOC adopted the Agency's Regulations for the Safe Transport of Radioactive Materials [32] as part of its own recommendations for the transport of dangerous goods. The Agency's regulations have also been extensively incorporated into the international convention for the transport of dangerous goods by rail, the relevant code of practice of IMCO and the regulations of IATA; they are furthermore being applied in a number of Member States.

154. In February 1966 the Agency arranged for a joint discussion of more detailed standards for the design and testing of packages for large radioactive sources. The discussion took place between the Agency's panel and a large number of experts from international transport organizations, and special attention was given to packages for transporting irradiated fuel.

155. The testing specifications contained in the Agency's regulations make it possible for national authorities to determine whether a particular model of package can be accepted or not. Proper testing of packages requires, however, special technical skills, experience and facilities. The Agency is therefore looking into the possibility of using one or more national testing facilities as an internationally recognized centre for testing packages from all Member States. This centre would also co-ordinate a collection of experimental and theoretical data on the performance of various packages.

156. The safety standards and safety tests jointly prepared by ENEA and the Agency for radioluminous time pieces have been approved by the Steering Committee of ENEA [33]. The Agency, ENEA and WHO are jointly studying the need for safety standards and tests for other commercial radioactive products, and the feasibility of establishing them.

157. A revision of an Agency document, which outlines the kind of assistance and services that may be made available by Member States in the event of a radiation accident, has been undertaken in collaboration with WHO. The new document is expected to be ready late in 1966, and a manual on planning for emergencies is being prepared.

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[31] Ibid., para. 156.

[32] Safety Series No. 6, 1964 Revised Edition.

[33] GC(IX)/299, para. 160.

158. A manual on environmental monitoring in emergency situations has been published [34].

159. A joint ILO/Agency panel has compiled a code of practice to govern radiation safety in uranium and thorium mines which will shortly be published. The recent recommendations of ICRP have been taken into account.

160. A survey of the standards used in Member States for permissible surface contamination in working areas has been carried out jointly with ILO and WHO.

161. A manual on methods of radiochemical analysis for assessing radioactive contamination of biological and environmental samples has been published jointly by FAO, WHO and the Agency. This manual is a revised edition of one published in 1959 by FAO and WHO [35].

162. A manual on techniques of controlling air pollution caused by nuclear facilities has been published [36]. It describes good ventilation practice for areas where radioactive materials are used, as well as the design and operation of devices for removing radioactive contamination from exhaust air.

163. A detailed guide-book on safety aspects of the design and equipment of high level radiochemical laboratories will be published in 1966. It is intended mainly as a guide to the engineering techniques used in modern design of these laboratories. A manual on the safety evaluation of such laboratories is also being prepared.

164. A manual on the safe use of radioisotopes in hydrology, describing health and safety measures in field work has been completed in consultation with WHO and FAO, and is being published. The Medical Addendum to the Manual on Safe Handling of Radioisotopes [37] has been revised jointly with ILO and WHO. The scope of the new document, entitled The Medical Supervision of Radiation Workers, is wider; in particular it now covers radiation accidents.

165. Following a meeting convened in Budapest in April 1966, steps are being taken to arrange an international exchange of information on radiation protection research and development. The arrangements would be similar to those described below which are already made with regard to waste management.

166. A symposium on practices in the treatment of low and intermediate level radioactive wastes, sponsored jointly by the Agency and ENEA, was held at Headquarters in December 1965. It dealt mainly with the practical aspects of the subject: techniques, operational procedures, design data, results obtained and the cost of treatment. The papers gave critical insight into such matters as the effectiveness and cost of various processes now used in waste treatment plants.

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[34] Safety Series No. 18.

[35] Methods of Radiochemical Analysis, World Health Organization, Technical Reports Series No. 173.

[36] Safety Series No. 17.

[37] Ibid., No. 3.

167. The panel of experts convened in December 1965 to discuss the economics of radioactive waste management made good progress towards the establishment of a uniform accounting system. A number of Member States are to contribute data which will allow some evaluation of the relative cost of various waste management operations. This work will be taken further at meetings in October 1966. The Secretariat has also begun a study of the various factors which, together with economies, must be taken into account in selecting a waste management system.

168. The Agency is preparing a report on the handling of the sludges and waste concentrates produced by the processing of low and intermediate level radioactive wastes. A technical addendum to the manual on waste management for radioisotope users [38] has been completed by a consultant provided cost free by the United States Government.

169. A manual on radioactive waste disposal into the ground, which provides general guidance for countries that may wish to use this method of disposal for low and intermediate level wastes, has been published. [39]

170. The disposal of radioactive wastes into seas and rivers has attracted much interest and some controversy. At a symposium on disposal of radioactive wastes into seas, oceans and surface waters which was held in Vienna in May 1966, a great deal of hitherto unpublished material was discussed. Many reports were presented on research into the ways in which nuclides are transported in waters and their associated environments. Reports on research during operating experience in some countries indicated that levels of radioactivity added to waters had been well below accepted international recommendations. All the discussions concerned low-level wastes discharged in liquid form, these forming the greatest part of radioactive disposal into waters.

171. Twenty-two Member States are now taking part in the programme for co-ordination of national research projects in radioactive waste management. Abstracts of articles about research in progress are being exchanged, and the Agency has published two collections of such abstracts [40]. The programme has been taken further by a meeting on physical and chemical properties of materials used for fixation and solidification of radioactive wastes in Dubna, Soviet Union, in November 1965. Nine countries advanced in research on the subject sent participants; the meeting compiled data on the properties of the materials in question and made recommendations for further co-ordinated research.

172. A further meeting, on the treatment and disposal of organic liquids contaminated with radioactive materials, was held in Belgium in April 1966, also for the purpose of compiling data and recommending lines of co-ordinated research.

173. The joint (ILO/FAO/Agency) Advisory Service in Radiation Protection and Waste Management has provided advice to 16 countries, in six cases by sending a specialist from the Secretariat. The main subjects of advice have been training and general radiological protection, treatment and disposal of radioactive wastes and radiation protection regulations.

174. A special advisory service has also been established by the Agency to review the safety of any proposed irradiated fuel movements.

175. To help health physics services in the ECAFE region the Agency held a study group meeting on this subject in Bangkok in November 1965. Twenty-eight health physicists from countries in the region participated and discussed their work and problems, recent

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[38] Ibid., Nos. 12 and 19 respectively.

[39] Ibid., No. 16.

[40] Waste Management Research Abstracts, publications Nos. 1 and 2.

advances in health physics, means of arranging regional co-operation and the Agency s own programme. The first steps were taken towards regional co-operation in dosimetry problems. It was clear that meetings of this kind can become a valuable part of the Agency's radiation protection programme, and a similar meeting will be held in Latin America in the latter part of 1966.

176. Eighteen specialists from Japan and South East Asian countries attended an advanced training seminar in waste management in Japan, in October 1965. Specialists from the Agency's staff took the opportunity to visit certain neighbouring countries and advise them on some of their waste management problems.

V. RESEARCH AND SERVICES IN PHYSICAL SCIENCES

(a) Chemistry

177. As in previous years this programme has concentrated on the exchange and assessment of data on the thermodynamics of nuclear materials, as well as on the use of research reactors and of large radiation sources in chemistry research.

178. The second symposium on thermodynamics of nuclear materials was held in Vienna in July 1965 in co-operation with the Commission on Thermodynamics and Thermochemistry of the International Union of Pure and Applied Chemistry. The effects of heat changes on reactor materials are vitally important in the design of nuclear reactors - particularly advanced reactors in which fuel elements and components are subjected to intense heat and radiation - and of chemical processing plants. A great deal of new data on both thermodynamic and transport properties was released and the importance of the critical assessment of such data was stressed at the symposium.

179. The study group meeting in Caracas [41], discussed chemical problems associated with reactor operation, and in particular problems of corrosion of fuel and components and of controlling the purity of water in pool-type research reactors.

180. The Lucas Heights [41] meeting also reviewed irradiation techniques that are of growing importance in chemistry. It also discussed the development of isotope production, hot atom chemistry, and radiation chemistry in South and East Asian nuclear centres.

181. Isotope production is of special importance to newly established reactor centres. A mission visited the National Tsinghua University, China, in March 1966 to advise on the isotope production programme there and to help draw up a programme for hot atom chemistry research. The Agency has published an experimental manual on isotope production, giving general advice to new centres about how to start production programmes as well as information about the actual production processes used by more than ten reactor centres.

182. The Agency's study group meetings in Asia and the Middle East have greatly stimulated co-operative research and have helped individual centres in China, the Philippines and Thailand, to draw up useful programmes of research and to start local production of isotopes. Good progress on similar lines is being made in Latin America.

(b) Physics

183. The programme under this heading comprised chiefly:

(a) Promotion of the exchange of nuclear data. These data encompass both microscopic cross-sections of importance to reactor designers, and bibliographic data important to all nuclear scientists;

(b) Promotion of the exchange of information and research co-ordination on nuclear fusion; and

(c) The work of the International Centre for Theoretical Physics at Trieste.

184. The Agency's aim is to arrange for a full and continuing world-wide exchange of numerical and bibliographical data. Success must depend on the co-operation of the three main data-producing centres: North America, Western Europe and Eastern Europe.

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[41] See para. 61 above.

North America and Western Europe have set up, in the ENEA Neutron Data Compilation Centre, effective arrangements for data exchange within their areas. Until the Agency has achieved its objectives, more distant countries which produce or are interested in data, such as Argentina, Australia, Brazil, India, Israel, Pakistan, South Africa and the United Arab Republic, may find themselves isolated from the three major data producers.

185. The progress achieved so far, while encouraging, has been uneven. The United States has agreed to proceed step by step to a full exchange of nuclear data. The ENEA Neutron Data Compilation Centre seems willing to do the same, provided it is assured of full reciprocity. The Soviet Union has agreed to scan all relevant Soviet literature beginning 1 January 1966. Individual specialists in Australia, India and Poland have begun systematically to supply information on their work.

186. By the time of the fourth meeting of the Agency s International Nuclear Data Scientific Working Group, in Tokyo in September 1965, it was felt that there had been enough progress to justify continuing the group s work. Henceforth the group is to be known as the International Nuclear Data Committee. After a two-year transitional period (1966-67) its terms of reference will be more closely defined, and in the meantime all possible steps will be taken to expand the data exchanges.

187. For the actual exchange of data, computer techniques are employed. Existing programmes written for other computers are being adapted to the Agency's machines and new programmes are being written for this work. The IBM 7040 computer in the Vienna Technische Hochschule which the Agency has already used in preparing a critical review of the constants of fissile nuclides [42], is also employed for this work, and supporting work is done on the IBM 1401 at Headquarters. A meeting in Tokyo in September 1965 showed that additional measurements of the number of neutrons per fission are needed.

188. The second conference on plasma physics and controlled nuclear fusion research was held at the Culham Laboratory in the United Kingdom in September 1965. Much of the conference was devoted to examining the results of many different experiments designed to provide a better understanding of the behaviour of plasma. Much progress has been made since the first conference in Salzburg in 1961 and there is growing confidence that the many problems of controlled fusion will be solved and that the goal will ultimately be achieved.

189. A panel convened in June 1966 on the use of lithium-drifted germanium gamma-ray detectors for research in nuclear physics will provide laboratories in Member States with information on their characteristics and properties and describe research applications in many fields, such as spectrometer analysis, neutron capture gamma rays, neutron inelastic scattering gamma rays and Mössbauer studies.

190. The pulsed neutron technique is a relatively cheap tool for training in neutron and reactor physics and for many kinds of research. [43]

191. The research contract in Yugoslavia on anisotropic diffusion coefficients (one of the characteristics or properties of neutron diffusion), in which the Agency's small pulsed neutron source is being used, will shortly be completed. Afterwards it is planned to lend the source to another laboratory in a developing country, or to a regional centre, where it can be used to start or further a reactor physics programme.

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[42] A Survey of Values of the 2200 m/s Constants for Four Fissile Nuclides, C.H. Westcott, K. Ekberg, G.C. Hanna, N.J. Pattenden, S. Sanatani and P.M. Attree. Atomic Energy Review, Vol. 3, No. 2 (1965) Vienna.

[43] GC(IX)/299, para. 144.

192. The second year of the International Centre of Theoretical Physics at Trieste began on 1 October 1965. Two research groups have started work: one in plasma physics under the leadership of Professors M. Rosenbluth and R. Z. Sagdeev, and the other in high energy and elementary particle physics under Professor A. Salam, the Director of the Centre.

193. During the reporting period 45 scientists from 20 countries (Austria, Brazil, Chile, Czechoslovak Socialist Republic, France, Ghana, India, Italy, Jamaica, Japan, the Netherlands, New Zealand, Norway, Pakistan, Poland, Sweden, Switzerland, the Soviet Union, the United Kingdom and the United States) worked at the Centre for periods from two to 12 months. Research done under the auspices of the Centre has been described in 80 publications which have been distributed to approximately 500 scientific institutions throughout the world.

194. For the academic year 1965-66, twenty fellowships have been awarded at the Centre to young scientists from Argentina, Austria, Brazil, Byelorussian SSR, China, Czechoslovak Socialist Republic, Federal Republic of Germany, India, Italy, Japan, Republic of Korea, Mexico, Poland, the United Arab Republic and Yugoslavia. The Agency and UNESCO are co-operating in sponsoring post-graduate training at the Advanced School of Physics of the University of Trieste. Fourteen of the Centre's fellows took advantage of these training facilities. Special lectures and seminars were given by scientists from the Centre and by guest scientists from abroad.

195. To sum up, the Centre is now well established, its success has exceeded expectations, and it is making a valuable contribution to international co-operation in theoretical nuclear physics, high energy and elementary particle physics, and plasma physics.

(c) The Laboratories

196. The work done during 1965 in the Agency's laboratories at Seibersdorf, at Headquarters and under the Monaco project, as well as the work of the Middle Eastern Regional Radioisotope Centre for the Arab Countries in Cairo is described in the third annual report on the Agency's laboratory activities [44].

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[44] IAEA Laboratory Activities, Third Annual Report; Technical Reports Series No. 55.

VI. SAFEGUARDS

197. As mentioned in the Introduction, the scope of the Agency's safeguards system has been extended in the past year.

(a) The Agency's Safeguards System (1965)

198. The revised safeguards system was approved by the Board immediately after the ninth regular session of the General Conference and has so far been incorporated in four safeguards transfer agreements, one unilateral submission agreement and one project agreement approved by the Board.

199. The revised system envisages the development of provisions relating to types of principal nuclear facilities other than reactors. Since at the present stage reprocessing plants are the most important facilities of this kind, the Board decided, on 22 February 1966, to re-establish the Working Group which had reviewed the original system. The Working Group was requested to make recommendations as soon as practicable on the extension of the Agency's safeguards system to reprocessing plants. All the members of the Board were invited to participate in the work of the Group, and Member States were given the opportunity to submit their views for its consideration.

200. The Working Group met from 11 to 13 May to consider these comments, together with a draft document on extension of the system. It proposed to the Board special procedures for safeguarding reprocessing plants. At its meetings in June the Board provisionally approved the special procedures as an annex to the Agency's Safeguards System (1965). In doing so the Board stressed the need to revise these procedures in the light of experience and of any suggestions made since the Working Group submitted its report, and decided that they would be subject to review at any time, and would be reviewed in any case after two years' experience of their application.

201. During 1965 the Resident Representative of the United States of America informed the Director General that his Government had reached agreements with the Governments and international organizations to which it supplied nuclear materials under bilateral arrangements whereby the United States would register with the Agency, on a semi-annual basis, all transfers of nuclear material under such agreements which were not otherwise reported to the Agency. Notifications covering the period from 1 July 1964 through 31 December 1965 have already been submitted. In accordance with suggestions made by certain delegates to the General Conference at its ninth regular session, the Director General has been consulting with the principal suppliers of nuclear materials concerning the possibility of setting up a system for reporting and registering all international transfers of such materials.

(b) Implementation of Agency safeguards

202. As shown in Table X below, by 30 June 1966 the Board had approved a total of 29 Safeguards Agreements with 23 Member States, as compared to 24 agreements with 21 Member States on 30 June 1965. Of these agreements, two safeguards transfer agreements were approved in the period under review, i.e. with Canada and Japan and with Brazil and the United States. During this period the Board also approved the project agreement relating to the research reactor in Uruguay. In June 1966 the Board approved an agreement with the United Kingdom for safeguarding the two gas-cooled natural uranium reactors of Bradwell Nuclear Power Station, each of which produces 538 MW(th) of power.

Table X

Safeguards Agreements approved by the Board of Governors
(except those that have expired or been cancelled)

State (s)	Subject	Entry into force	INFCIRC
Project Agreements			
Argentina	RAEP Reactor	1 Dec 1964	62
Congo, Democratic Republic of	TRICO Reactor	27 Jun 1962	37
Finland	FiR-1 Reactor	30 Dec 1960	24
	FINN Sub-critical assembly	30 Jul 1963	53
Japan	JRR-3 Reactor	24 Mar 1959	3
Mexico	TRIGA III Reactor	18 Dec 1963	52
Norway	NORA Reactor	10 Apr 1961	29
Pakistan	PRR Reactor	5 Mar 1962	34
Uruguay	Uruguay research reactor	24 Sep 1965	67
Yugoslavia	TRIGA II Reactor	4 Oct 1961	32
	(Bilateral co-operation agreements between the indicated States)		
Transfer Agreements			
Argentina/USA		1 Mar 1966	79
Austria/USA		13 Dec 1965	76
Brazil/USA			
Canada/Japan		20 Jun 1966	85
China/USA		29 Oct 1965	72
Denmark/UK		23 Jun 1965	63
Greece/USA		13 Jan 1966	78
Iran/USA			
Israel/USA		15 Jun 1966	84
Japan/USA		1 Nov 1963	47
Japan/UK			
Norway/USA			
Philippines/USA		24 Sep 1965	69
Portugal/USA		15 Dec 1965	77
South Africa/USA		8 Oct 1965	70
Thailand/USA		10 Sep 1965	68
Viet-Nam/USA		25 Oct 1965	71
Unilateral submissions			
United Kingdom	Bradwell Facility	1 Sep 1966	86
United States	Yankee Nuclear Power Station	1 Aug 1964	57
	Brookhaven graphite research reactor		
	Brookhaven medical research reactor		
	Piqua organic moderated research reactor		

203. Once the safeguards agreements listed above have all come into force, they will cover the 54 reactor facilities listed in Table XI below. The aggregate thermal capacity of these facilities is around 2485 MW.

Table XI

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

Member State	Name of reactor	Location	Type	Capacity MW(th)	In operation	Maximum routine inspections per year[c]
Argentina	RA-1/Argentine Reactor 1	Constituyentes	Argonaut	.00	x	0
	RA-2/Argentine Reactor 2	Constituyentes	Argonaut	.00		1
	RAEP/Reactor Argentino de Experimentación y Producción	Ezeiza	Pool-tank	5.00		1
Austria	SAR/Argonaut Graz Research Reactor	Graz	Argonaut	.00	x	0
	AUSTRIAN TRIGA MARK II Research Reactor	Vienna	Triga II	.25	x	0
	ASTRA	Seibersdorf	Pool-tank	5.00	x	2
(Brazil)	(IEAR-1)	São Paulo	Pool	5.00	x	0
	(TRIGA I)	Belo Horizonte	Triga I	.00	x	0
	(ARGONAUT)	Rio de Janeiro	Argonaut	.00	x	0
China	THOR/Tsing Hua Open Pool Reactor	Hsin-chu	Pool	1.00	x	1
Congo, Democratic Republic of	TRICO	Leopoldville	Triga I	.05	x	0
Denmark	DR-3	Risø	Tank	10.00	x	3
Finland	FiR-1	Otaniemi	Triga II	.25	x	0
Greece	GRR/Greek Research Reactor	Athens	Pool	1.00	x	1
(Iran)	(UTRR)	Teheran	Pool	1.00		0
Israel	IRR-1	Yavne	Pool	5.00	x	2
Japan	JRR-1/Japan Research Reactor 1	Tokai-mura	Aqu.-hom.	0.05	x	0
	JRR-2/Japan Research Reactor 2	Tokai-mura	Tank	10.00	x	3
	JRR-4/Japan Research Reactor 4	Tokai-mura	Pool	1.00	x	1
	JPDR/Japan Power Demonstration Reactor	Tokai-mura	Boiling-Water	46.70	x	2

Member State	Name of reactor	Location	Type	Capacity MW(th)	In operation	Maximum routine inspections per year[c/]
Japan (cont.)	SHCA/Semi-Homogeneous Critical Assembly	Tokai-mura	Crit. Fac.	.00	x	1
	AHCF/Aqueous Homogeneous Critical Facility	Tokai-mura	Crit. Fac.	.00	x	0
	TCA/Tank-type Critical Assembly	Tokai-mura	Crit. Fac.	.00	x	0
	Mitsubishi Research Reactor	Tokai-mura	Pool			0
	Sumitomo Critical Assembly	Tokai-mura	Crit. Fac.	.00	x	0
	JMTR/Japan Material Testing Reactor Crit. Ass.	Tokai-mura	Crit. Fac.	.00	x	2
	Rikkyo University Research Reactor	Yokosuka-shi	Triga II	.10	x	0
	Musashi College of Technology Research Reactor	Kawasaki-shi	Triga II	.10	x	0
	Kinki University Research Reactor	Fuse-shi	UTR-B	.00	x	0
	TRR/Toshiba Research Reactor	Kawasaki-shi	Pool	.03	x	0
	HTR/Hitachi Training Reactor	Kawasaki-shi	Pool	.10	x	1
	HCA/Hitachi Critical Assembly	Kawasaki-shi	Crit. Fac.	.10	x	1
	Nippon Atomic Industry Group Crit. Ass.	Kawasaki-shi	Crit. Fac.	.00	x	1
	KUR/Kyoto University Research Reactor	Kumatori-cho	Pool	1.00	x	2
	(Tokai-mura Nuclear Power Station)	Tokai-mura	Magnox	585.00	x	A
Mexico	National Institute of Nuclear Energy Reactor	Mexico City	Triga III	1.00		0
Norway	NORA	Kjeller	Tank	.10	x	1
	(JEEP)	Kjeller	Tank	.45	x	0
	(JEEP-2)	Kjeller	Tank	2.00	x	0
	(HWBR/Halden Heavy Boiling-Water Reactor)	Halden	Tank	20.00	x	1

Member State	Name of reactor	Location	Type	Capacity MW(th)	In operation	Maximum routine inspections per year[c/]
Pakistan	PRR/Pakistan Research Reactor	Rawalpindi	Pool	5.00	x	2
Philippines	PRR-1/Philippine Research Reactor	Diliman	Pool	1.00	x	0
Portugal	RPI/Portuguese Research Reactor	Sacavem	Pool	1.00	x	1
South Africa	SAFARI-1	Pelindaba	Tank	7.00	x	2
Thailand	TRR-1/Thai Research Reactor 1	Bangkok	Pool	1.00	x	1
United Kingdom	Two reactors at the Bradwell Nuclear Power Station	Bradwell	Magnox (2)	1100.00	x	A
United States of America	BGRR/Brookhaven Graphite Research Reactor	Long Island (N.Y.)	Graph. Mod.	20.00	x	A
	BMRR/Brookhaven Medical Research Reactor	Long Island (N.Y.)	Tank	3.00	x	1
	PNPF/Piqua Nuclear Power Facility	Piqua (O.)	Org. Mod.	45.50	x	2
	YANKEE Nuclear Power Station	Rowe (Mass.)	Press. Water	600.00	x	A
Uruguay	URR/Uruguay Research Reactor	Montevideo	Lockheed	.10		0
Viet-Nam	VNR-1/Viet-Nam Research Reactor 1	Dalat	Triga II	.25	x	0
Yugoslavia	Yugoslavian Triga II	Ljubljana	Triga II	.25	x	0

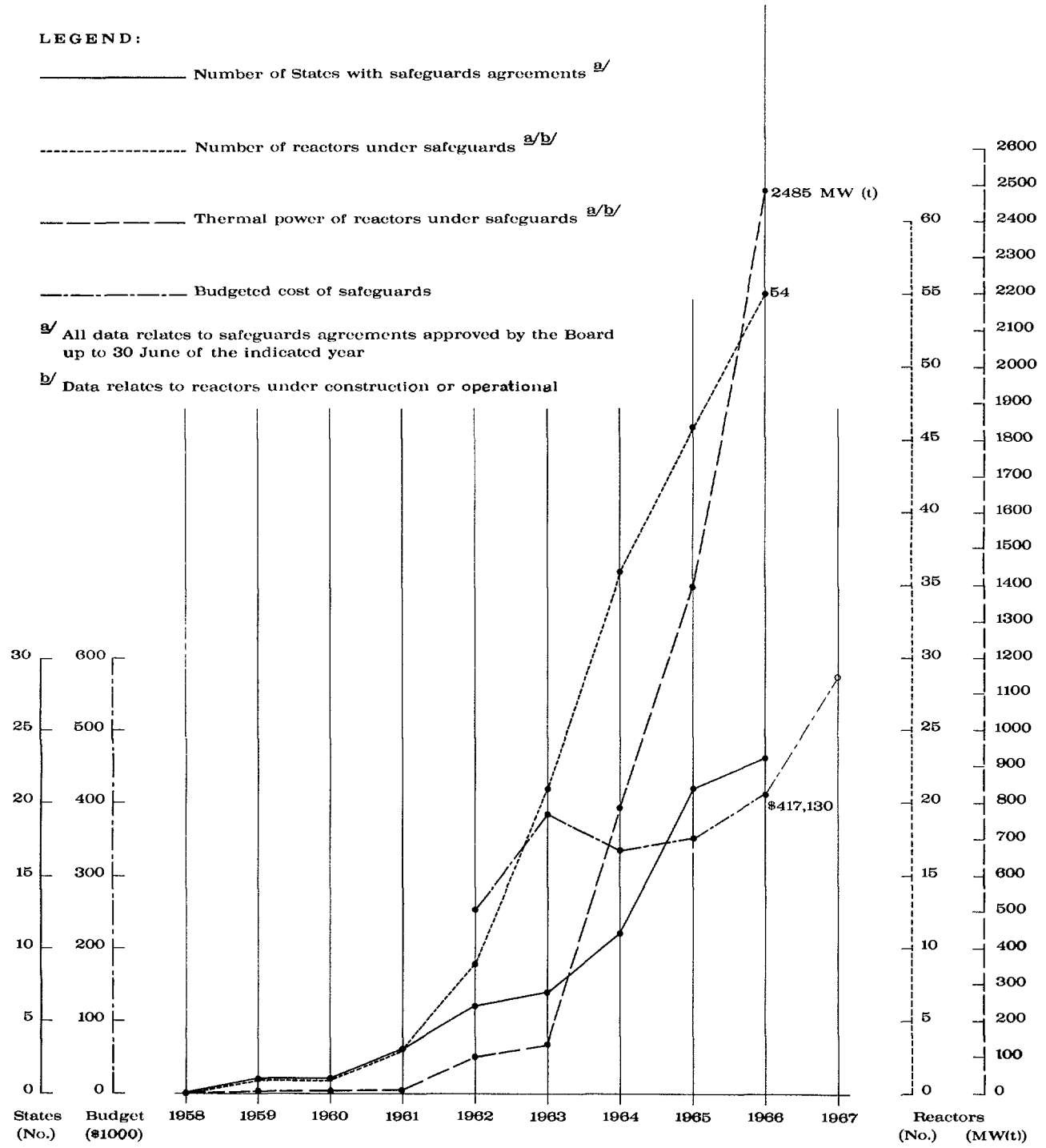
a/ As defined in documents INFCIRC/26, Part II, para. 14 and INFCIRC/66, Part IV, para. 80.

b/ Where Member State and name of reactor are given in brackets, the agreement is not yet in force.

c/ A = Access at all times.

204. The following graph presents significant numerical data on safeguards for the period since the inception of the Agency's safeguards programme. In the graph account has not been taken of research facilities and principal nuclear facilities other than reactors.

GROWTH OF AGENCY SAFEGUARDS



(c) Safeguards inspections

205. During the past year inspections were made of 25 facilities in 12 Member States. In addition, Agency officials made pre-operational visits to nine facilities in seven Member States, in order to complete arrangements for the entry into force or the implementation of safeguards agreements being negotiated or already concluded. In most cases these visits were made in conjunction with inspection travel.

(d) Safeguards records system

206. A system of records has been set up at the Agency for dealing with the information obtained from Member States on items subject to safeguards. These records consist essentially of operational and accounting reports, joint inventory notification, facility design data and other relevant information. The data are analysed to obtain overall balances and to verify information obtained during inspections. Up to the previous year, the records system had been a simple book-keeping operation; it has now been completely reorganized and transformed into a reliable machinery for dealing with a variety of operating conditions. The accounting data are processed by mechanical and electronic equipment and every effort is made to eliminate errors. The new system is expected to result in a considerable increase in output with only a minimum increase in man-hours.

(e) Research and development programme

207. Generally speaking, the emphasis of this programme has continued to shift from theoretical studies to the development of practical equipment and techniques. Attention has been paid mainly to developments which would improve the application of safeguards to existing facilities. This change in approach has resulted in a lag in the award of new research contracts, but the application to safeguarded reactors of devices developed under current and past contracts (more specifically, a monitoring device for reactor fuel charge/discharge machines, and a photovoltaic monitor for integrated reactor power determination) was actively explored and is still under consideration. Work has also been done at the Agency's Laboratory on developing a technique for the determination of the integrated power of heavy-water reactors by measuring tritium concentration.

(f) Symposium on nuclear materials management

208. A symposium on nuclear materials management was held at Vienna from 30 August to 3 September 1965. It was the first international meeting of its kind, and was attended by 115 participants from 19 Member States and two international organizations. Among the matters discussed were the scientific and administrative aspects of handling nuclear materials, from the point of view of ensuring safe and economical operation. These subjects have a direct bearing on safeguards practices.

VII. INFORMATION AND RELATED TECHNICAL SERVICES

(a) General

209. The main factors affecting the Agency's work as an international centre for the exchange of information on nuclear science are the rapid growth in the amount of data being produced and the corresponding rapid progress in the electronic, mechanical and optical means of handling, storing and retrieving information (computers, microfiche). To meet the information needs of its Member States, the Agency itself is employing the most efficient techniques and acquiring the necessary equipment. It is also, with the aid of UNESCO, helping to introduce these techniques into the nuclear science information services of its developing Member States.

210. Another development is the reorienting of certain international science information services that have hitherto been rendered by one or two of the most advanced Member States. This places new responsibilities on, and offers opportunities for useful work to, regional and international organizations.

211. Co-ordination is especially necessary in technical information services. Regional organizations such as ENEA and EURATOM have several effective programmes for their Member States and are contemplating new ones. UNESCO's work, covering the whole range of scientific information, is well known. In conformity with various resolutions of the General Conference and directives from the Board, the Secretariat is making arrangements for co-operation in subjects such as the exchange and reproduction of nuclear science information in general, the exchange of computer programmes, and the joint organization of scientific meetings. In this way it is hoped that duplication can be avoided.

(b) Scientific meetings

212. Since the Third International Conference on the Peaceful Uses of Atomic Energy in 1964, the Agency has resumed its normal pattern of specialized scientific conferences, symposia and seminars. In 1965 a total of 15 scientific meetings was held, [45] of which five were co-sponsored by other international organizations. A total of 2161 persons representing 49 countries and ten organizations participated in the meetings, at which 829 papers were presented. Further details about meetings held in 1965 and planned for 1966 are given in Annex III, parts A and B.

(c) Publications

213. The Agency's editing and publication services publish scientific and technical material produced by the Secretariat and the proceedings of Agency meetings.

214. 25 000 pages were published in 1965 and about 12 000 during the first half of 1966. 35 000 copies of publications were sold in 1965, and yielded an income of $104 000. Income from sales during the first half of 1966 is about $50 000-$60 000. The problems of selling publications for non-convertible currencies are gradually being overcome and sales in several of the countries concerned are expected to rise.

215. A number of innovations have been made to reduce the cost of publications and shorten the time needed to issue them - particularly the proceedings of scientific meetings. One method, for instance, is direct reproduction from original manuscripts or tables. Details of the Agency's publications programme are given in Annex III, part C.

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[45] Based on the Agency's Programme for 1965-66 (document GC(VIII)/275, para. 186). Certain other meetings were considered necessary after discussions at the Third Geneva Conference.

(d) Documentation

216. The Agency has rented an electronic data-processing machine (type 1401) together with the requisite auxiliary facilities. The machine started operating in October 1965 and is being used to prepare lists of references, bibliographies and other material that must periodically be brought up to date. A special system has been devised to code the bibliographical material and to prepare different types of indices.

217. The ground has been prepared by consultations with Member States and international organizations, for international co-operation in the scanning of scientific and technical literature, in the preparation and distribution of abstracts, and in the introduction of automated methods for these tasks. Some new problems were discussed at a panel in June 1965. A further meeting of the main centres concerned will be held later this year to consider what must be done to ensure full and continued international coverage and abstracting, as well as exchange of nuclear science information. The abstracting board of ICSU has been asked to draw up a comprehensive list of periodicals in the nuclear field, and to arrange with the editors of these periodicals that abstracts are made of all relevant articles and that titles and abstracts are prepared in conformity with international standards.

218. Individual periodicals of the Agency, particularly the Atomic Energy Review and Nuclear Fusion, continue to be in demand; however, the List of Periodicals in the Field of Nuclear Energy has been discontinued.

(e) Library

219. The library now holds 31 500 books, 80 000 reports and receives about 1000 periodicals. It receives all reports of the United States Atomic Energy Commission, and has a large collection of Russian-language literature on nuclear energy. It maintains an up-to-date collection of the atomic energy legislation of Member States. Its films include 600 in the field of nuclear energy, of which about half are usually on loan.

VIII. ADMINISTRATION

(a) External relations

(i) The United Nations and the specialized agencies

220. The Agency's reports to the General Assembly for the years 1963-64 and 1964-65 were presented by the Director General on 18 November 1965. In its Resolution 2056(XX) the General Assembly expressed appreciation for the help given by the Agency to the holding of the Third International Conference on the Peaceful Uses of Atomic Energy and decided to consider, at its 22nd Session (in 1967), the question of holding further conferences on this subject. Several delegates suggested that any further conferences should be limited in scope and size, and that the necessity of holding them, as well as their size, should be determined by the activities of the Agency.

221. The work of the United Nations family on the subject of water desalination in developing countries was discussed by ECOSOC at its 39th session in July 1965 and its 40th session in February 1966. At the earlier session it asked the Secretary-General to explore means of accelerating progress in this domain, in consultation with the specialized agencies concerned and with the Agency. The secretariats of the United Nations and of the Agency have enlarged their work on this subject. Various arrangements have been made for co-operation - thus, for instance, members of the Agency's Secretariat took part in the United Nations seminar in September 1965 on the economics of water desalination, and the United Nations Secretariat seconded two experts to the combined energy and desalting mission sent by the Agency to Chile and Peru in March and April 1966. [46]

222. The General Conference will be aware of the steps taken to create the United Nations Organization for Industrial Development. The Secretariat has kept the United Nations Industrial Development Centre informed of the Agency's various activities that contribute to industrialization, and is seeking arrangements for co-operation and avoiding potential duplication.

223. The Secretariat has also made recommendations to the United Nations Advisory Committee on the Application of Science and Technology to Development about the topics, concerned with nuclear energy and its applications, to which priority should be given. These topics are referred to in the report of the Agency to ECOSOC for 1965-66 [47].

224. Information is given in part III of this report of the progress made in setting up the Joint FAO/IAEA Division of Atomic Energy in Agriculture. The liaison arrangements between the Agency and WHO [48] have continued, and progress has been made in ensuring that there is consultation between the two agencies at the early stage of programming and in avoiding undesirable duplication. The Directors General of both agencies are following this matter closely.

225. Arrangements have been made with the International Bank for Reconstruction and Development for an informal exchange of information about power and energy programmes of interest in Member States. Co-operation with UNESCO, ILO and IMCO has continued on the lines described in last year's report. [49]

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[46] See para. 85 above.

[47] INFCIRC/80.

[48] GC(IX)/299, paras. 209 and 210.

[49] Ibid., paras. 211-214.

(ii) Regional matters

226. Pursuant to General Conference Resolution GC(XVIII)/RES/179, the Director General has continued consultations with OAU regarding a relationship agreement to provide for co-operation between the Agency and the Scientific and Technical Research Commission of that organization. OAU has agreed to send its comments on proposals submitted by the Director General.

227. Co-operation with ENEA is referred to in several sections of this report. The work of the two agencies is becoming increasingly interdependent, particularly in connection with the exchange of scientific information.

228. Arrangements have been made for the executive heads, or senior officials, of COMECON, ENEA, EURATOM and IANEC to visit the Agency and inform the Secretariat and delegations of work in fields of mutual interest, and to consult on various programmes.

229. The arrangement for stationing a regional officer for Asia and the Far East in Bangkok has been extended for another year. [50]

(b) Personnel

230. On 30 June 1966 the Secretariat had 297 staff members in the Professional category and above. 286 of these, of whom three were on secondment to other United Nations organizations, held permanent or fixed-term contracts, and 11 were serving under Special Service Agreements. 284 were serving at Headquarters, 5 at Trieste, 4 in Monaco, 2 at New York and 1 each at Geneva and in Bangkok. The number of staff members holding posts that were subject to geographical distribution was 231; they came from 47 Member States. The Secretariat also had 434 General Service staff, 10 of whom were serving in Monaco and 10 at Trieste, and 182 in the Maintenance and Operatives Service. The total strength of the Agency's staff was thus 913 [51].

231. The organizational chart of the Agency's Secretariat below shows the structure of the Secretariat as at 30 June 1966.

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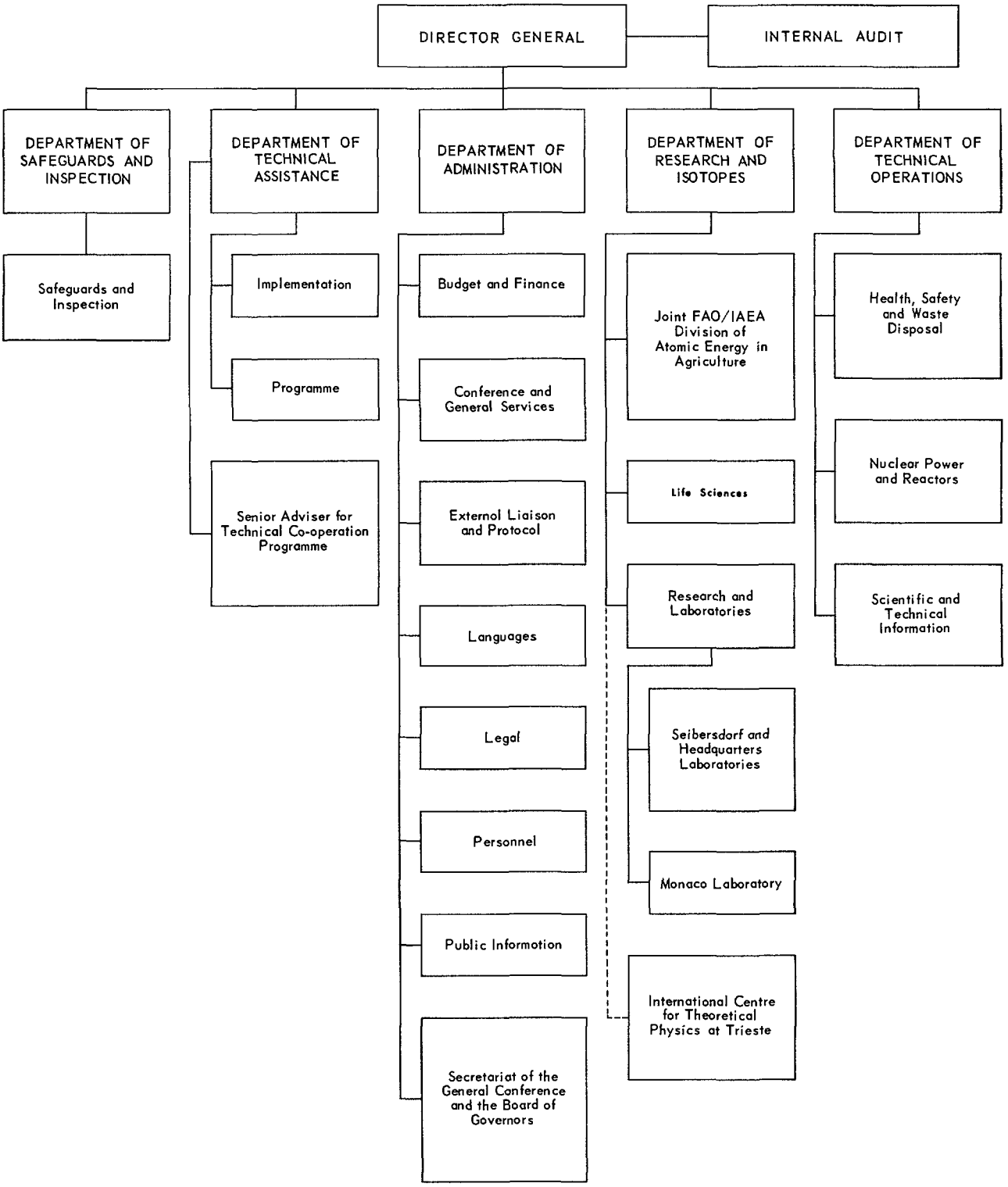
[50] Ibid., para. 222.

[51] Details of the Agency's staff are to be found in document INFCIRC/22/Rev. 6, the Annex to which contains statistical information on staff members who held posts that were subject to geographical distribution.

Organizational Chart



(c) Finance

(i) Regular Budget

The financial year 1965

232. The assessment of contributions for 1965 of Member States included in the scale of assessment for that year amounted to $7 713 000. The additional assessment of six new Member States (Costa Rica, Cyprus, Jamaica, Kenya, Kuwait and Madagascar) increased the total by $19 282 to $7 732 282.

233. By 31 December 1965, the Agency had received contributions towards the Regular Budget for 1965 amounting to $6 943 041, which represents 89.79% of the total assessment. By 30 June 1966 $6 507 305 or 89.98% of the total contributions due had been received. [52]

234. The Agency's obligations for 1965 amounted to $7 875 184 which resulted in budgetary savings of $62 816 from the appropriations for 1965. A further $98 391 from miscellaneous income and assessments on new Member States brought the total budgetary surplus at 31 December 1965 to $161 207, as follows:

Budgetary savings		$ 62 816
Contributions assessed on new Member States		19 282
Excess of miscellaneous income over budget:		
Actual miscellaneous income	$304 109	
Less: Budget	225 000	79 109
Budgetary surplus for 1965		$161 207

Although the budgetary surplus for 1965 was $161 207, contributions outstanding for the same year amounted to $789 241, leaving a provisional cash deficit of $628 034.

235. Unliquidated obligations in respect of 1965 appropriations at 31 December 1965 were $822 998, of which $428 475 had been liquidated by 30 June 1966.

236. As authorized by the Board in June 1965, a transfer of $10 000 was made from Section 4 - Special missions, to Section 6 - Distribution of information, and under the authority to transfer any additional savings under any section to Section 8 - Salaries and wages, in order to cover increased costs, a total of $85 000 was transferred from Section 3 - Panels and committees ($20 000), Section 5 - Seminars, symposia and conferences ($30 000) and Section 7 - Scientific and technical services and laboratory charges ($35 000).

The financial year 1966

237. By 30 June 1966 the following advances to the Working Capital Fund and contributions to the Regular Budget for 1966 had been received:

Advances to the Working Capital Fund	$1 998 400
Contributions to the 1966 Regular Budget	$2 791 920

By that date Member States had thus paid 99.79% of the total advances due to the Working Capital Fund and 33.09% of the total contributions due to the 1966 Regular Budget. [53]

[52] See Annex VI, Part B.

[53] Ibid., Parts A and C.

(ii) Operational Budget

238. Of a total amount of $1 256 920 pledged to the General Fund for 1965, $824 906 had been paid by 31 December 1965. By 30 June 1966 the total pledged was increased to $1 332 193 and receipts amounted to $855 706, leaving a balance of $476 487 still to be paid. With regard to the target of $2 million set for 1965 by the General Conference at its eighth regular session, there was a shortfall of approximately $668 000 in the actual pledges made by Member States.

239. The total operational obligations incurred during 1965 amounted to $1 836 169. Unliquidated obligations at 31 December 1965, including obligations brought forward from previous years, amounted to $830 433.

240. The total amount pledged to the General Fund for 1966 at 30 June 1966 was $1 161 667 of which $237 400 had been paid by that date. [54]

(iii) The Agency's resources in 1965

241. Resources equivalent to approximately $12 650 000 were at the Agency's disposal during 1965 under its own programmes, EPTA, Special Fund projects and other special projects, including contributions in cash, services and in kind. Details concerning these resources are set out in Table XII below:

[54] Ibid., Part D.

Table XII

Resources at the disposal of the Agency in 1965

Administrative Fund	$	$
Assessed contributions to the Regular Budget		
Member States included in the scale for 1965	7 713 000	
New Members	19 282	7 732 282
Actual miscellaneous income		304 109
General Fund		
Voluntary contributions to the General Fund for 1965		1 256 920
Adjustment of previous years' contributions		63 467
Miscellaneous income (from investments, laboratory, local project costs, exchange differences)		137 620
Income from the Agency/United States Atomic Energy Commission Research Programme		26 195
Special voluntary contributions pledged:		
Italian contribution for Trieste Centre	278 176	
Monaco contribution for Monaco Laboratory	40 816	318 992
Publications Revolving Fund		
Expenditure including unliquidated obligations in 1965		75 674
Special Accounts		
Saudi Arabian Project Trust Fund		25 000
Joint Research Programme of the Agency and the United States Atomic Energy Commission		101 506
Special fellowships offered by the Government of the Union of Soviet Socialist Republics		-
United Nations Korean Reconstruction Agency Residual Fund		4 000
EPTA		
Earmarkings from contributions and other available funds in 1965		1 024 685
Special Fund		
Funds allocated during 1965		883 200
Contributions in services and in kind		
Type II fellowships awarded		530 400
Technical assistance equipment and supplies		77 700
Laboratory equipment and supplies		30 050
Library, etc.		12 499
Special nuclear materials		50 000
Total resources		12 654 299

(d) Legal matters

242. By 30 June 1966, 387 agreements to which the Agency is a party had entered into force and had accordingly been registered with the Agency, in implementation of Article XXII. B of the Statute. Of these, 75 were registered during the period covered by this report, and 25 were registered with the United Nations pursuant to Article 102 of its Charter.

243. During the period covered by this report, Cuba, the Philippines and the United Arab Republic ratified the Vienna Convention on Civil Liability for Nuclear Damage. The Philippines has also ratified the Optional Protocol concerning the Compulsory Settlement of Disputes. An Instrument of Acceptance in accordance with Article XXIV of the Convention has been deposited by Trinidad and Tobago.

244. The Agreement on the Privileges and Immunities of the Agency is now in force between the Agency and 22 of its Member States.

245. In relation to Resolution GC(VIII)/RES/177, adopted by the General Conference in 1964, a revised draft of a multilateral agreement on emergency assistance, which had been prepared by the Secretariat, was discussed by a committee composed of experts from 16 Member States which met in Vienna from 13 to 18 December 1965. The committee's report was subsequently discussed by the Board, which appointed a Committee of the Whole to draft multilateral and bilateral agreements for its consideration.

246. The Committee of the Whole held meetings from 23 to 27 May 1966, and reported to the Board in June. The Board decided to postpone discussion of the draft agreements prepared by the Committee, and requested the Director General to circulate a progress report to Member States for their information and comments. It further requested the Director General to place the subject on the provisional agenda both for the meetings the Board will hold in September and for the tenth regular session of the General Conference. [55]

(e) Public information

247. The growing importance of nuclear power and of questions raised by the spread of nuclear energy has stimulated public interest in the Agency's work and offered many new opportunities for informing the world's press and other information media of the Agency's objectives and achievements.

248. Special efforts were made in connection with the International Co-operation Year.

249. The ninth regular session of the General Conference in Tokyo provided a particularly useful opportunity to reach the public all over the world. The Japanese press, radio and television showed a lively interest not only in the conference but in the Agency itself. The office of the Director General's Representative at the United Nations Headquarters has also been active in arranging to bring the Agency's work to the notice of the North American public and of associations concerned with atomic energy.

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[55] The progress report will be circulated as document GC(X)/335.

ANNEX I

THE BOARD OF GOVERNORS

To 28 September 1965	1965-1966	From 28 September 1965
Afghanistan[a]		
	Argentina[b]	
	Australia[c/d]	
		Austria[e]
Belgium[f]		
	Brazil[c/d]	
	Canada[c/d]	
	Chile[b]	
China[a]		
		Colombia[e]
Congo, Democratic Republic of[a]		
		Czechoslovak Socialist Republic[g]
Finland[f]		
	France[c/d]	
		Ghana[e]
	India[c/d]	
	Japan[c/d]	
		Korea, Republic of[e]
Morocco[a]		
	Netherlands[b]	
		Pakistan[e]
Poland[f]		
		Portugal[g]
Romania[a]		
	South Africa[c/d]	
		Sweden[g]
Switzerland[a]		
	Thailand[b]	
		Tunisia[e]
	Union of Soviet Socialist Republics[c/d]	
	United Arab Republic[b]	

To 28 September 1965	1965-1966	From 28 September 1965
	United Kingdom of Great Britain and Northern Ireland[c/d]	
	United States of America[c/d]	
Uruguay[a]		
		Yugoslavia[e]

a/ Elected by the General Conference on 1 October 1963 under Article VI.A.3 of the Statute.

b/ Elected by the General Conference on 18 September 1964 under Article VI.A.3 of the Statute.

c/ Designated by the Board on 10 June 1964 under Article VI.A.1 of the Statute.

d/ Designated by the Board on 16 June 1965 under Article VI.A.1 of the Statute.

e/ Elected by the General Conference on 27 September 1965 under Article VI.A.3 of the Statute.

f/ Designated by the Board on 10 June 1964 under Article VI.A.2 of the Statute.

g/ Designated by the Board on 16 June 1965 under Article VI.A.2 of the Statute.

ANNEX II

NUCLEAR POWER STATIONS IN MEMBER STATES

Name	Location	Type	Net output (MW(e))	Criticality date
		A. Power reactors in operation		
Belgium				
BR-3	Mol	Press., H_2O 3.7 + 4.4% U	10.5	Aug 1962
Canada				
NPD	Rolphton	Press., D_2O nat. U	22.5	Apr 1962
France				
G-1	Marcoule	Nat. U, graphite, air	3	Jan 1956
G-2 (G-3)	Marcoule	Nat. U, graphite, CO_2	2 x 40	Jul 1958/Jun 1959
CHINON-1 (EDF-1)	Chinon	Nat. U, graphite, CO_2	60	Sep 1962
CHINON-2 (EDF-2)	Chinon	Nat. U, graphite, CO_2	200	Aug 1964
CHINON-3 (EDF-3)	Chinon	Nat. U, graphite, CO_2	475	Mar 1966
Germany, Federal Republic of				
KAHL	Grosswelzheim/ Kahl (Main)	Boiling, H_2O 2.6% U	15	Nov 1960
MZFR	Karlsruhe	Press., D_2O nat. U	50	Sep 1965
Italy				
LATINA (SIMEA)	Latina (Foce Verde)	Nat. U graphite, CO_2	200	Dec 1962
GARIGLIANO (SENN)	Garigliano (Sessa Aurunca)	Boiling, H_2O 2% U	150	Jun 1963
ENRICO FERMI (SELNI)	Trino Vercellese	Press., H_2O 2.6% U	186[a/]	Jun 1964
Japan				
JPDR	Tokai-Mura	Boiling, H_2O 2.5% U	11.7	Aug 1963
TOKAI-MURA	Tokai-Mura	Nat. U, graphite, CO_2	158	May 1965

Name	Location	Type	Net output (MW(e))	Criticality date
Sweden				
AGESTA	Agesta	Press., D_2O nat. U	9	Jul 1963
United Kingdom				
CALDER HALL	Calder Hall	Nat. U graphite, CO_2	4 x 45	May 1956/Mar 1959
CHAPELCROSS	Chapelcross	Nat. U graphite, CO_2	4 x 45	Oct 1958/Dec 1959
DFR	Dounreay	Fast breeder 45.5% U, NaK	15	Nov 1959
BERKELEY	Berkeley	Nat. U graphite, CO_2	2 x 138	Aug 1961/Mar 1962
BRADWELL	Bradwell	Nat. U graphite, CO_2	2 x 150	Aug 1961/Apr 1962
AGR	Windscale	2.5% U graphite, CO_2	34	Aug 1962
HUNTERSTON	Hunterston	Nat. U graphite, CO_2	2 x 150	Sep 1963/Apr 1964
HINKLEY POINT	Hinkley Point	Nat. U graphite, CO_2	2 x 250	May 1964/late 1964
TRAWSFYNYDD	Trawsfynydd	Nat. U graphite, CO_2	2 x 250	Sep 1964/Dec 1964
SIZEWELL	Sizewell	Nat. U graphite, CO_2	2 x 289	Jun 1965/Dec 1965
DUNGENESS A	Dungeness	Nat. U graphite, CO_2	2 x 275	Jun 1965/Sep 1965
United States of America				
EBWR	Lemont	Boiling, H_2O 1.5 + 90% U	4	Dec 1956
SRE	Santa Susana	Graphite-sodium 90% U + Th	7.5	Apr 1957
SHIPPINGPORT	Shippingport	Press., H_2O nat. + 93% U	100	Dec 1957
DRESDEN	Morris	Boiling, H_2O 1.5% U	200	Oct 1959
YANKEE	Rowe	Press., H_2O 3.4% U	175	Aug 1960
SAXTON	Saxton	Press., H_2O 5.7% U	3	Apr 1962
INDIAN POINT	Indian Point	Press., H_2O 93% U + Th	210	Aug 1962

Name	Location	Type	Net output (MW(e))	Criticality date
BIG ROCK POINT	Charlevoix	Boiling, H_2O 3.2% U	72	Sep 1962
ERR	Elk River	Boiling, H_2O 93% U + Th	22	Nov 1962
HUMBOLDT BAY	Humboldt Bay	Boiling, H_2O 2.6% U	68.5	Feb 1963
CVTR	Parr	Press., D_2O 1.5 + 2.0% U	17	Mar 1963
PNPF	Piqua	Organic 1.9% U	11.4	Jun 1963
ENRICO FERMI	Laguna Beach	Fast breeder 25% + nat. U	60.9	Aug 1963
EBR-2	Idaho Falls	Fast breeder 49% + nat. U, Na	16.5	Nov 1963
NPR	Richland	0.9% U graphite, H_2O	776	Dec 1963
PATHFINDER	Sioux Falls	Nucl. superheat 2.2 + 93% U	58.5	Mar 1964
BONUS	Punta Higuera	Nucl. superheat nat. + 3% U	16.5	Apr 1964
HTGR	Peach Bottom	93% U + Th, graphite, He	40	Mar 1966
Union of Soviet Socialist Republics				
APS	Obninsk	Press., H_2O 5% U, graphite	5	May 1954
SIBERIAN	Troitsk	Nat. U graphite, boiling, H_2O	600 (6 x 100)	Sep 1958/Dec 1962
TES-3	Obninsk	Press., H_2O enr. UO_2	1.5	1961
ARBUS	Melekess	Organic 36% UAl_4 + Al	0.75	Jun 1963
URAL I	Beloyarsk	Nucl. superheat 1.3% U	94	Sep 1963
WWER I	Novo Voronezh	Press., H_2O 1.5% U	196	Dec 1963
VK-50 (Ulyanovsk)	Melekess	Boiling, H_2O 1.5% U	70	Apr 1965

Name	Location	Type	Net output (MW(e))	Criticality date
		B. Power reactors under construction		
Canada				
CANDU-PHW-200	Douglas Point	Press., D_2O nat. U	203	1966
CANDU-PHW-500	Pickering Township	Press., D_2O nat. U	2 x 505	1970/1971
Czechoslovak Socialist Republic				
HWGCR	Bohunice	Nat. U, D_2O CO_2	150	1968
France				
CHOOZ (SENA)[b]	Chooz	Press., H_2O 3.1% U	266	1966
EL-4	Brennilis	Enr. U D_2O, CO_2	73	1967
SAINT LAURENT DES EAUX-1 (EDF-4)	Saint Laurent des Eaux	Nat. U graphite CO_2	475	1968
SAINT LAURENT DES EAUX-2[c]	Saint Laurent des Eaux	Nat. U graphite CO_2	475	1969/1970
BUGEY-1 (EDF-5)	Bugey near Lyon	Nat. U graphite CO_2	475	1970/1971
Germany, Federal Republic of				
AVR	Jülich	Pebble bed 90% U, Th graphite, He	13.2	1966
KRB	Gundremmingen	Boiling, H_2O enr. U	237	1966
KWL	Lingen	Boiling, H_2O fossile superheat, enr. UO_2	250	1968
KWO	Obrigheim	Press., H_2O 3% UO_2	283	1968
HDR	Grosswelzheim/ Kahl (Main)	Boiling, H_2O nuclear superheat enr. UO_2	25	1968
India				
TARAPUR	Tarapur	Boiling, H_2O	2 x 190	1968
RAJASTHAN-1	Rana Pratap Sagar	Press., D_2O nat. U	200	1969

Name	Location	Type	Net output (MW(e))	Criticality date
Netherlands				
DODEWAARD	Dodewaard	BWR ("direct cycle")	47	1968
Pakistan				
KANUPP	Paradise Point near Karachi	Press., D_2O nat. U	132	1969
Spain				
ZORITA I	Zorita de los Canes	Press., H_2O	153.2	1968
Sweden				
R-4/EVA	Marviken	Boiling, D_2O 1.35% enr. UO_2	140[d]	1968
Switzerland				
LUCENS	Lucens	1% U, D_2O, CO_2	7.5	1966
United Kingdom				
OLDBURY	Oldbury	Nat. U graphite CO_2	2 x 300	1966
SGHWR	Winfrith	1.4% U, D_2O boiling, H_2O	93	1967
WYLFA	Anglesey, Wales	Nat. U graphite CO_2	2 x 590	1968
DUNGENESS B	Dungeness	Graphite, enr. U, CO_2	2 x 600	1970
PFR	Dounreay	Sodium-cooled, fast breeder prototype	250	1971
United States of America				
LACBWR	Genoa	Boiling, H_2O 3.4% U	50	1966
SAN ONOFRE	San Clemente	Press., H_2O 3.6% U	375	1967
CONNECTICUT YANKEE	Haddam Neck	Press., H_2O 3-4% U	462	1967
OYSTER CREEK	Oyster Creek	Boiling, H_2O	515	1968
NINE MILE POINT	Oswego, N.Y.	Boiling, H_2O	500	1967
INDIAN POINT-II	Indian Point	Press., H_2O	873[e]	1969
DRESDEN-2	Morris	Boiling, H_2O	714	1969

Name	Location	Type	Net output (MW(e))	Criticality date
Union of Soviet Socialist Republics				
Ural-II	Beloyarsk	Nucl. superheat 1.3% U BWR	200	1966
WWER-II	Novo Voronezh	Press., H_2O 1.5% U	365	1966
BN-350	Shevchenko (Caspian Sea)	Fast breeder 23% UO_2 + Pu, Na (dual-purpose reactor for electricity production and water desalination)	150	

a/ To be raised to 257 MW(e).

b/ Electricity production is equally shared between Belgium and France.

c/ Reactor actually being mounted in shops.

d/ To be raised to 200 MW(e) with nuclear superheat.

e/ To be raised to 1000 MW(e).

ANNEX III

CONFERENCES, SYMPOSIA AND PUBLICATIONS

A. Conferences and symposia held in 1965

Date and place	Title	Co-sponsoring organizations	Number of participants	Number of countries represented	Number of organizations represented	Number of papers presented
8-12 March Vienna	Symposium on Personnel Dosimetry for Accidental High-Level Exposure to External and Internal Radiation	WHO	179	34	5	48
22-26 March Salzburg (Austria)	Symposium on the Physics and Chemistry of Fission		190	29	5	79
10-14 May Karlsruhe (Federal Republic of Germany)	Symposium on Pulsed Neutron Research		217	23	3	87
17-21 May Bucharest	Symposium on Non-Destructive Testing in Nuclear Technology		90	19	2	46
24-28 May Vienna	Symposium on Radio-isotope Sample Measurement Techniques in Medicine and Biology		203	31	3	53
31 May-4 June Brookhaven (United States)	Symposium on Exchange Reactions		46	9	1	29
28 June-2 July Ankara	Symposium on the Use of Isotopes and Radiation is Soil-Plant Nutrition Studies	FAO	68	28	2	43
22-27 July Vienna	Symposium on Thermodynamics, with Emphasis on Nuclear Materials and Atomic Transport in Solids	IUPAC	162	22	2	68

Date and place	Title	Co-sponsoring organizations	Number of participants	Number of countries represented	Number of organizations represented	Number of papers presented
30 August-3 September Vienna	Symposium on Nuclear Materials Management		115	19	2	58
6-10 September Culham (United Kingdom)	Conference on Plasma Physics and Controlled Nuclear Fusion Research		268	25	3	102
18-22 October Warsaw	Symposium on Radioisotope Instruments in Industry and Geophysics		222	23	3	59
25-29 October Vienna	Symposium on the Use of Isotopes in Weed Research	FAO	67	18		15
1-5 November Stockholm	Symposium on Criticality Control of Fissile Materials		113	18	3	43
22-26 November Bombay (India)	Conference on Nuclear Electronics		65	12	2	48
6-10 December Vienna	Symposium on Practices in the Treatment of Low- and Intermediate-Level Radioactive Wastes	ENEA	156	26	4	51

B. Conference and symposium programme for 1966

Date	Title	Place	Co-sponsoring organizations
16-20 May	Symposium on the Disposal of Radioactive Wastes into Seas, Oceans and Surface Waters	Vienna	
6-10 June	International Symposium on Food Irradiation	Karlsruhe (Federal Republic of Germany)	FAO
4-8 July	International Symposium on Magneto-hydrodynamic Electrical Power Generation	Salzburg (Austria)	ENEA
12-15 July	Seminar on the Use of Radioisotopes and Radiation in Dairy Science and Technology	Vienna	FAO
29 August-2 September	Symposium on Neutron Monitoring for Radiological Protection	Vienna	
5-9 September	Symposium on the Use of Isotopes in Plant Nutrition and Physiology	Vienna	FAO
3-7 October	Symposium on Solid-State and Chemical Radiation Dosimetry in Medicine and Biology	Vienna	
10-14 October	Symposium on Standardization of Radionuclides	Vienna	
17-21 October	Conference on Nuclear Data, Microscopic Cross-Sections and other Data Basic for Reactors	Paris	
24-28 October	Seminar on Safety Problems in Agricultural Use of Radioisotopes	Vienna	
31 October-4 November	Symposium on Agricultural and Public Health Aspects of Radioactive Contamination in Normal and Emergency Situations	Teheran?	FAO/WHO
7-11 November	Symposium on Radiation Sensitivity and Recovery from Radiation Effects in Biological Systems	Budapest?	
14-18 November	Symposium on the Use of Isotopes in Hydrology	Varna? (Bulgaria)	
21-25 November	Symposium on the Application of Radio-isotope Tracers in Industry and Geophysics	Prague	
12-16 December	Seminar on Tropical Medicine	Lagos	

C. Agency publications[a]

1. Proceedings of Conferences, Symposia and Seminars[b]

Criticality Control of Fissile Materials
Exchange Reactions
High-Energy Physics and Elementary Particles
Isotopes and Radiation in Soil-Plant Nutrition Studies
Isotopes in Weed Research
Non-Destructive Testing in Nuclear Technology, two volumes
Nuclear Electronics
Nuclear Materials Management
Personnel Dosimetry for Radiation Accidents
Physics and Chemistry of Fission, two volumes
Plasma Physics and Controlled Nuclear Fusion Research, two volumes
Pulsed Neutron Research, two volumes
Radioisotope Instruments in Industry and Geophysics, two volumes
Radioisotope Sample Measurement Techniques in Medicine and Biology
Thermodynamics, two volumes

2. Technical Directory

Atlas of Radiation Dose Distributions, Volume I: Single-Field Isodose Charts

3. Safety Series

No. 6 Regulations for the Safe Transport of Radioactive Materials (1964 Revised Edition)[c]
No. 12 The Management of Radioactive Wastes Produced by Radioisotope Users[d]
No. 15 Radioactive Waste Disposal into the Ground
No. 16 Manual on Environmental Monitoring in Normal Operations
No. 17 Techniques for Controlling Air Pollution from the Operation of Nuclear Facilities
No. 18 Environmental Monitoring in Emergency Situations
No. 19 The Management of Radioactive Wastes Produced by Radioisotope Users: Technical Addendum

4. Bibliographical Series

No. 15 Radioisotopes and Ionizing Radiations in Entomology (1961-1963)
No. 16 The Mössbauer Effect
No. 17 Organic Coolants and Moderators
No. 18 Neutron Detectors

5. Technical Reports Series

No. 43 Clinical Dosimetry[e]
No. 44 Advances in Insect Population Control by the Sterile-Male Technique
No. 45 Radioisotope Techniques in the Study of Protein Metabolism
No. 46 In-Pile Dosimetry
No. 47 Radioactivity[f]
No. 48 Plant Nutrient Supply and Movement
No. 49 Use of Plutonium for Power Production
No. 50 Applications of the Mössbauer Effect in Chemistry and Solid-State Physics
No. 51 Nuclear Energy for Water Desalination
No. 52 Utilization of Thorium in Power Reactors
No. 53 IAEA Research Contracts, Sixth Annual Report

Technical Reports Series (continued)

No. 54 Application of Food Irradiation in Developing Countries
No. 55 IAEA Laboratory Activities, Third Report
No. 56 Pressure Vessel Codes: Their Application to Nuclear Reactor Systems

6. Journals

Nuclear Fusion - Journal of Plasma Physics and Thermonuclear Fusion, Volume 5, Nos. 3 and 4; Volume 6, No. 1
Atomic Energy Review, Volume 3, Nos. 3 and 4; Cumulative Index, Volumes 1-3; Volume 4, Nos. 1 and 2; Special Issue, No. 1
International Atomic Energy Agency Bulletin, Volume 7, Nos. 3 and 4; Volume 8, Nos. 1 and 2[d/]

7. Miscellaneous

Conferences, Meetings, Training Courses in Atomic Energy, Nos. 37-42
IAEA Film Catalogue, No. 4
Legal Series, No. 3: Agreements Registered with the International Atomic Energy Agency
Legal Series, No. 4: International Conventions on Civil Liability for Nuclear Damage
List of References on Nuclear Energy, Volume 7, Nos. 13-24; Volume 8, Nos. 1-12; Index 1963
Publications in the Nuclear Sciences (Catalogue)[g/]

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a/ Published in English, unless otherwise indicated.

b/ Contributions published in the original language (English, French, Russian or Spanish) with abstracts in English, French, Russian and Spanish. Discussions in English.

c/ Published in English, French, Russian and Spanish.

d/ Published in Russian.

e/ Published in French and Russian.

f/ Published in French, Russian and Spanish.

g/ Published in English, French, Russian, Spanish and German.

ANNEX IV

RESEARCH CONTRACTS

A. Total value of contracts 1964 and 1965

Year	New contracts	Renewals	Total	Value[a/]
1964	55	77	132	762 391
1965	69	88	157	845 917

a/ From the Agency's funds. In addition, eleven contracts to the value of $175 395 were awarded or renewed in 1964 and four contracts to the value of $76 133 were renewed in 1965 from funds made available by the United States Government under the United States/Agency Joint Research Programme.

B. Analysis by subject matter of contracts awarded or renewed in 1965

Subject matter of research	Number of contracts placed	Number of contracts renewed	Contribution from Regular Budget	Contribution from Operational Budget	Total
			$	$	$
Radioactive waste management and environmental research	3	6	90 187	-	90 187
Health physics and radiation protection	8	9	101 620	-	101 620
Radiation biology	13	7	79 620	-	79 620
Studies involving reactors	4	5	77 877	-	77 877
Applications of radioisotopes in agriculture	14	31	112 015	61 598	173 613
Food irradiation	4	6	43 250	-	43 250
Application of radioisotopes in hydrology	7	4	57 740	-	57 740
Application of radioisotopes in medicine	16	20	141 840	80 170	222 010
Total	69	88	704 149	141 768	845 917

C. Analysis by country of contracts awarded or renewed in 1965

Country	Number of contracts placed	Number of contracts renewed	Contribution from Regular Budget	Contribution from Operational Budget	Total
Argentina	3	-	19 400	-	19 400
Australia	2	-	14 400	-	14 400
Austria	3	1	24 070	-	24 070
Belgium	3	3	26 200	4 000	30 200
Bolivia	1	-	-	10 960	10 960
Brazil	1	1	4 450	4 200	8 650
Bulgaria	2	-	9 900	-	9 900
Burma	-	1	-	2 650	2 650
Ceylon	1	1	2 540	3 650	6 190
Chile	1	1	4 000	9 650	13 650
China	-	3	3 790	5 698	9 488
Colombia	-	1	-	3 100	3 100
Congo, Democratic Republic of	-	2	5 000	-	5 000
Czechoslovak Socialist Republic	2	2	23 700	-	23 700
Ecuador	-	2	10 500	-	10 500
El Salvador	1	-	6 000	-	6 000
Finland	-	1	9 000	-	9 000
France	1	-	7 000	-	7 000
Germany, Federal Republic of	2	4	40 920	-	40 920
Ghana	2	-	16 970	-	16 970
Greece	-	1	6 000	-	6 000
Guatemala	1	-	4 300	-	4 300
Hungary	3	2	25 920	-	25 920
India	2	3	28 662	6 150	34 812
Iraq	2	-	6 500	7 400	13 900
Israel	2	1	18 800	-	18 800
Italy	2	3	27 400	-	27 400
Jamaica	-	1	5 740	-	5 740
Japan	5	9	67 930	-	67 930
Kenya	1	-	4 700	-	4 700
Korea, Republic of	3	5	16 915	10 490	27 405
Lebanon	1	2	4 740	8 500	13 240
Madagascar	-	1	3 660	-	3 660
Morocco	1	-	4 500	-	4 500
Netherlands	3	1	12 700	-	12 700
Nigeria	-	2	1 000	3 230	4 230
Norway	-	1	4 200	-	4 200
Pakistan	3	5	23 340	9 300	32 640
Peru	-	1	-	4 350	4 350
Philippines	2	2	11 650	3 650	15 300

Country	Number of contracts placed	Number of contracts renewed	Contribution from Regular Budget	Contribution from Operational Budget	Total
Poland	2	3	25 397	-	25 397
Portugal	-	1	4 760	-	4 760
Rhodesia	-	1	-	7 000	7 000
Romania	-	4	25 520	-	25 520
South Africa	1	2	15 020	-	15 020
Spain	1	2	19 140	-	19 140
Sweden	-	1	12 300	-	12 300
Switzerland	1	1	10 180	-	10 180
Thailand	-	4	7 880	7 690	15 570
Turkey	1	1	10 700	5 150	15 850
United Arab Republic	2	3	21 350	4 550	25 900
United Kingdom of Great Britain and Northern Ireland	1	1	8 250	-	8 250
Uruguay	1	-	-	20 400	20 400
Union of Soviet Socialist Republics	3	-	30 115	-	30 115
Yugoslavia	-	1	7 040	-	7 040
Total	69	88	704 149	141 768	845 917

ANNEX V

CONTRIBUTIONS OF EQUIPMENT BY MEMBER STATES

A. Equipment offered as contributions in kind

1. The General Conference will recall the offers to establish medical radiological centres in developing countries, made by the Governments of Bulgaria, the Byelorussian Soviet Socialist Republic, the Czechoslovak Socialist Republic, Hungary, Poland, Romania, the Ukrainian Soviet Socialist Republic and the Union of Soviet Socialist Republics. [1]

2. During the reporting period, equipment for such centres requested by Burma and Iraq was donated by the Soviet Union.

3. The radiological centre which was offered by the Government of the Czechoslovak Socialist Republic to Algeria started to operate during the reporting period.

B. Equipment donated as contributions in kind

4. The table below lists equipment donated during the reporting period for furthering the purposes of the Agency.

Equipment donated to the Agency's Laboratory

Donor country	Equipment
France	A 4096-channel 2-parameter gamma-ray spectrometer and a 2-Ci ^{60}Co source
Japan	1 mass-spectrometer for isotopic analysis and 1 scaler

5. In 1965 the United States donated equipment grants in kind for the projects within the Agency's approved programme, as listed overleaf.

[1] GC(IX)/299, Annex V, paras. 1-3.

Equipment donated for approved technical assistance projects in Member States

Recipient country	Equipment
Brazil	A plant growth chamber
Chile	Some components for a spin resonance spectrometer
China	A medical scintillation scanning system
Colombia	Actigraph paper electrophoresis system and vacuum distilling apparatus
Pakistan	For scientific documentation project microcard reader, Recordak microfile machine, Recordak reader-printer. Film processing equipment, photo-copy machine, roll to roll printer, etc.
Philippines	Laboratory monitors, survey meters, analysis unit kit, ionization meter and miscellaneous radio-chemical accessories
Thailand	Hygrothermograph, low temperature cabinets moisture testers laboratory counters vacuum-pressure pump and other accessories
Uruguay	Carborne scintillometer assembly for uranium prospecting

ANNEX VI

FINANCE

A. Advances to the Working Capital Fund

Member	Assessed $	Paid $	Outstanding $
Afghanistan	1 000	1 000	-
Albania	800	800	-
Algeria	1 800	1 800	-
Argentina	16 600	16 600	-
Australia	28 400	28 400	-
Austria	9 600	9 600	-
Belgium	20 800	20 800	-
Bolivia	800	800	-
Brazil	17 200	17 200	-
Bulgaria	3 000	3 000	-
Burma	1 000	1 000	-
Byelorussian Soviet Socialist Republic	9 400	9 400	-
Cambodia	800	800	-
Cameroon	800	800	-
Canada	57 200	57 200	-
Ceylon	1 400	1 400	-
Chile	4 800	4 800	-
China	76 600	76 600	-
Colombia	4 200	4 200	-
Congo, Democratric Republic of	1 000	1 000	-
Costa Rica	800	-	800
Cuba	3 600	3 600	-
Cyprus	800	800	-
Czechoslovak Socialist Republic	20 000	20 000	-
Denmark	11 200	11 200	-
Dominican Republic	800	800	-
Ecuador	1 000	1 000	-
El Salvador	800	800	-
Ethiopia	800	800	-
Finland	7 800	7 800	-
France	109 800	109 800	-
Gabon	800	800	-
Germany, Federal Republic of	133 600	133 600	-
Ghana	1 400	1 400	-
Greece	4 600	4 600	-
Guatemala	800	800	-
Haiti	800	800	-
Holy See	800	800	-
Honduras	800	800	-
Hungary	10 000	10 000	-

Member	Assessed $	Paid $	Outstanding $
Iceland	800	800	-
India	33 400	33 400	-
Indonesia	7 000	7 000	-
Iran	3 600	3 600	-
Iraq	1 400	1 400	-
Israel	3 000	3 000	-
Italy	45 800	45 800	-
Ivory Coast	800	800	-
Japan	50 000	50 000	-
Kenya	800	800	-
Korea, Republic of	2 400	2 400	-
Kuwait	1 000	1 000	-
Lebanon	1 000	1 000	-
Liberia	800	800	-
Libya	800	800	-
Luxembourg	1 000	1 000	-
Madagascar	800	800	-
Mali	800	800	-
Mexico	14 600	14 600	-
Monaco	800	800	-
Morocco	2 000	2 000	-
Netherlands	20 000	20 000	-
New Zealand	6 800	6 800	-
Nicaragua	800	800	-
Nigeria	3 000	3 000	-
Norway	8 000	8 000	-
Pakistan	6 600	6 600	-
Paraguay	800	-	800
Peru	1 600	1 600	-
Philippines	6 200	6 200	-
Poland	26 200	26 200	-
Portugal	2 800	2 800	-
Romania	6 200	6 200	-
Saudi Arabia	1 200	1 200	-
Senegal	800	800	-
South Africa	9 400	9 400	-
Spain	13 200	13 200	-
Sudan	1 000	1 000	-
Sweden	22 800	22 800	-
Switzerland	15 800	15 800	-
Syrian Arab Republic	1 000	-	1 000
Thailand	2 600	2 600	-
Tunisia	1 000	1 000	-
Turkey	6 200	6 200	-
Ukrainian Soviet Socialist Republic	35 400	35 400	-

Member	Assessed $	Paid $	Outstanding $
Union of Soviet Socialist Republics	268 800	268 800	-
United Arab Republic	4 200	4 200	-
United Kingdom of Great Britain and Northern Ireland	130 000	130 000	-
United States of America	638 200	638 200	-
Uruguay	1 800	1 800	-
Venezuela	9 000	9 000	-
Viet-Nam	1 400	1 400	-
Yugoslavia	6 400	6 400	-
Total	2 000 000	1 997 400	2 600
New Members			
Jamaica	1 000	1 000	-
Jordan	800	-	800
Panama	800	-	800
Total for new Members	2 600	1 000	1 600

B. Outstanding contributions towards the 1958, 1959, 1960, 1961, 1962, 1963, 1964 and 1965 Regular Budgets

Member	1958 $	1959 $	1960 $	1961 $	1962 $	1963 $	1964 $	1965 $	Total $
Afghanistan	-	-	-	-	-	3 101	3 610	3 857	10 568
Algeria	-	-	-	-	-	-	-	235	235
Argentina	-	-	-	-	-	-	-	61 083	61 083
Chile	-	-	-	-	-	-	-	14 430	14 430
China	-	-	-	-	-	-	257 620	323 946	581 566
Colombia	-	-	-	-	-	-	-	16 630	16 630
Costa Rica	-	-	-	-	-	-	-	3 085	3 085
Cuba	-	-	-	10 394	15 111	14 245	14 440	15 426	69 616
Dominican Republic	-	-	-	-	3 015	3 561	3 610	3 857	14 043
Ecuador	-	-	-	-	-	-	2 064	4 628	6 692
Ethiopia	-	-	-	-	-	-	2 862	3 857	6 719
Guatemala	-	-	-	-	-	-	862	3 857	4 719
Haiti	-	2 021	2 337	2 467	2 652	2 849	2 888	3 085	18 299
Honduras	1 635	2 090	2 337	2 467	2 652	2 849	2 888	3 085	20 003
Hungary	-	-	-	-	-	-	14 000	36 251	50 251
Indonesia	-	-	-	-	-	-	-	26 629	26 629
Iran	-	-	-	-	-	-	-	12 183	12 183
Italy	-	-	-	-	-	-	-	152 436	152 436
Ivory Coast	-	-	-	-	-	-	-	2 871	2 871
Korea, Republic of	-	-	-	-	-	-	-	10 465	10 465
Mali	-	-	-	-	-	-	-	2 727	2 727
Paraguay	1 636	2 090	2 337	2 467	2 652	2 849	2 888	3 085	20 004
Peru	-	-	-	-	-	-	-	5 699	5 699
Syrian Arab Republic	-	-	-	-	-	3 561	3 610	3 857	11 028
Uruguay	-	-	-	-	-	6 922	7 220	7 713	21 855
Total outstanding	3 271	6 201	7 011	17 795	26 082	39 937	318 562	724 977	1 143 836
Total paid	4 111 489	5 218 799	5 873 969	6 182 895	6 613 997	7 115 326	6 911 712	6 507 305	
Total assessed	4 114 760	5 225 000	5 880 980	6 200 690	6 640 079	7 155 263	7 230 274	7 232 282	
Percentage paid of assessment	99.92	99.88	99.88	99.71	99.61	99.44	95.59	89.98	

C. Contributions to the 1966 Regular Budget

Member	Assessed $	Credits $	Paid $	Outstanding $
Afghanistan	4 213	-	-	4 213
Albania	3 371	-	214	3 157
Algeria	7 584	-	-	7 584
Argentina	69 940	-	-	69 940
Australia	119 656	10 423	54 617	54 616
Austria	40 447	842	20 502	19 103
Belgium	87 636	7 127	80 509	-
Bolivia	3 371	-	214	3 157
Brazil	72 468	6 872	-	65 596
Bulgaria	12 640	937	-	11 703
Burma	4 213	520	-	3 693
Byelorussian Soviet Socialist Republic	39 604	2 763	-	36 841
Cambodia	3 371	214	-	3 157
Cameroon	3 371	-	3 371	-
Canada	240 998	15 631	225 367	-
Ceylon	5 898	14	5 884	-
Chile	20 224	-	-	20 224
China	322 735	-	-	322 735
Colombia	17 695	-	-	17 695
Congo, Democratic Republic of	4 213	-	520	3 693
Costa Rica	3 371	-	-	3 371
Cuba	15 168	-	-	15 168
Cyprus	3 371	-	3 371	-
Czechoslovak Socialist Republic	84 265	4 326	-	79 939
Denmark	47 188	2 283	44 905	-
Dominican Republic	3 371	-	-	3 371
Ecuador	4 213	-	-	4 213
El Salvador	3 371	214	3 157	-
Ethiopia	3 371	-	-	3 371
Finland	32 863	815	32 048	-
France	462 615	28 913	433 702	-
Gabon	3 371	-	603	2 768
Germany, Federal Republic of	562 890	-	281 115	281 775
Ghana	5 898	627	-	5 271
Greece	19 381	721	-	18 660
Guatemala	3 371	-	-	3 371
Haiti	3 371	-	-	3 371
Holy See	3 371	214	3 157	-
Honduras	3 371	-	-	3 371
Hungary	42 132	-	-	42 132
Iceland	3 371	214	3 157	-
India	140 722	14 038	126 684	-
Indonesia	29 493	-	-	29 493
Iran	15 168	-	-	15 168
Iraq	5 898	627	5 271	-

Member	Assessed $	Credits $	Paid $	Outstanding $
Israel	12 640	547	12 093	-
Italy	192 967	-	-	192 967
Ivory Coast	3 371	-	-	3 371
Japan	210 662	3 013	207 649	-
Kenya	3 371	-	-	3 371
Korea, Republic of	10 112	-	-	10 112
Kuwait	4 213	-	4 213	-
Lebanon	4 213	267	3 946	-
Liberia	3 371	161	-	3 210
Libya	3 371	214	-	3 157
Luxembourg	4 213	267	3 946	-
Madagascar	3 371	-	3 371	-
Mali	3 371	-	-	3 371
Mexico	61 513	2 631	58 882	-
Monaco	3 371	214	3 157	-
Morocco	8 426	1 294	-	7 132
Netherlands	84 265	3 566	32 000	48 699
New Zealand	28 650	2 829	25 821	-
Nicaragua	3 371	214	225	2 932
Nigeria	12 640	800	11 840	-
Norway	33 706	2 442	31 264	-
Pakistan	27 807	3 282	-	24 525
Paraguay	3 371	-	-	3 371
Peru	6 741	-	-	6 741
Philippines	26 122	3 175	22 947	-
Poland	110 387	3 700	50 000	56 687
Portugal	11 797	1 001	10 796	-
Romania	26 122	1 202	12 660	12 260
Saudi Arabia	5 056	320	4 736	-
Senegal	3 371	467	2 904	-
South Africa	39 604	3 016	36 588	-
Spain	55 615	6 871	48 744	-
Sudan	4 213	520	3 693	-
Sweden	96 062	7 607	-	88 455
Switzerland	66 569	6 299	60 270	-
Syrian Arab Republic	4 213	-	-	4 213
Thailand	10 954	1 201	9 753	-
Tunisia	4 213	267	3 946	-
Turkey	26 122	3 175	-	22 947
Ukrainian Soviet Socialist Republic	149 149	10 771	34 300	104 078
Union of Soviet Socialist Republics	1 132 522	80 551	261 300	790 671
United Arab Republic	17 695	-	1 628	16 067
United Kingdom of Great Britain and Northern Ireland	547 722	46 829	-	500 893
United States of America	2 688 896	169 567	-	2 519 329
Uruguay	7 584	-	-	7 584

Member	Assessed $	Credits $	Paid $	Outstanding $
Venezuela	37 919	3 163	-	34 756
Viet-Nam	5 898	2 401	3 497	-
Yugoslavia	26 965	2 469	18 522	5 974
Sub-total	8 426 500	474 648	2 313 059	5 638 793
New Members				
Jamaica	4 213	-	4 213	-
Jordan	3 371	-	-	3 371
Panama	3 371	-	-	3 371
Sub-total	10 955	-	4 213	6 742
Total	8 437 455	474 648	2 317 272	5 645 535

D. Voluntary contributions to the Agency's General Fund for 1965 and 1966

Member	Contributions pledged (Equivalent in United States dollars at Technical Assistance Board rates)		Paid	
	$		$	
	1965	1966	1965	1966
Argentina	15 000	16 600[a]	-	-
Australia	20 000	20 000	20 000	20 000
Austria	8 200[a]	9 600[a]	8 200	-
Belgium	10 000	-	10 000	-
Bolivia	800[a]	-	-	-
Brazil	19 000[ab]	17 200[ab]	19 000	-
Burma	1 000	1 000[a]	1 000	-
Canada	57 400[a]	57 200[a]	57 400	-
Ceylon	2 100[ab]	2 100[ab]	2 100	-
China	5 000	5 000	5 000	-
Colombia	-	1 000[b]	-	-
Congo, Democratic Republic of	2 000[a]	-	-	-
Denmark	10 600[a]	11 200[a]	10 600	11 200
El Salvador	-	800[a]	-	800
Ethiopia	1 000[a]	-	-	-
Finland	6 800[a]	7 800[a]	6 800	7 800
France	30 612	-	30 612	-
Germany, Federal Republic of	104 800[a]	120 000	104 800	60 000
Ghana	1 600[a]	1 400[a]	1 600	-
Greece	4 200[a]	4 600[a]	4 200	-
Guatemala	500	-	500	-
Holy See	2 000[a]	2 000[a]	2 000	2 000
India	35 000[b]	35 000[ab]	35 000	35 000
Indonesia	2 000	2 000	2 000	-
Iran	2 000	2 000	2 000	-
Iraq	1 600[a]	1 400[a]	1 600	1 400
Israel	2 800[ab]	3 000[ab]	2 800	3 000
Italy	41 400[a]	45 800[a]	-	-
Japan	40 000	50 000[a]	40 000	50 000
Korea, Republic of	3 000	2 400[a]	-	-
Kuwait	800[a]	1 000[a]	800	1 000
Lebanon	1 000[a]	1 000[a]	1 000	1 000
Liberia	6 301[a]	-	6 301	-
Madagascar	-	800[a]	-	800
Mali	800[a]	-	800	-
Mexico	13 600[a]	[c]	13 600	-
Monaco	2 000[a]	2 000[a]	2 000	-
Morocco	2 600[a]	-	2 600	-
Netherlands	18 600[a]	18 600	18 600	-
New Zealand	-	5 000	-	5 000

Member	Contributions pledged (Equivalent in United States dollars at Technical Assistance Board rates)		Paid $	Paid $
	1965	1966	1965	1966
Norway	8 200[a]	8 000[a]	8 200	-
Pakistan	6 000[b]	6 000[b]	6 000	-
Peru	1 800[a]	-	-	-
Philippines	4 000[b]	6 200[ab]	4 000	6 200
Portugal	3 600[a]	3 600[a]	3 600	3 600
Saudi Arabia	1 200[a]	-	1 200	-
South Africa	9 800[ab]	9 400[a]	9 800	-
Spain	10 000	10 000	-	-
Sweden	24 000[a]	23 000[a]	24 000	-
Switzerland	17 600[ab]	15 800[a]	17 600	15 800
Thailand	3 000[a]	2 600[a]	3 000	-
Turkey	4 444[b]	6 400[a]	4 444	6 400
United Arab Republic	11 500[ab]	11 500[ab]	11 500	-
United Kingdom of Great Britain and Northern Ireland	140 000[ab]	130 200[a]	140 000	-
Uruguay	2 000[a]	-	-	-
Venezuela	-	9 000[a]	-	-
Viet-Nam	2 449[b]	1 400[ab]	2 449	-
Yugoslavia	7 000[ab]	6 400[ab]	7 000	6 400
	732 706	697 000	655 706	237 400
United States of America (including matching contribution)	599 487[d]	464 667[e]	200 000	-
Total	1 332 193	1 161 667	855 706	237 400

a/ Pledge based on a percentage equal to or higher than the Member's percentage assessment under the Regular Budget.

b/ Pledge announced in local currency.

c/ Amount to be announced later.

d/ Equivalent to 45% of the total pledged by all Member States including the United States.

e/ Equivalent to 40% of the total pledged by all Member States including the United States.