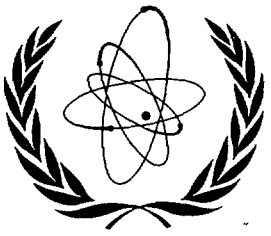

International Atomic Energy Agency

ANNUAL REPORT OF THE BOARD OF GOVERNORS TO THE GENERAL CONFERENCE

1 July 1966 - 30 June 1967

GC(XI)/355

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CONTENTS

ANNEXES

List of abbreviations

Agency	International Atomic Energy Agency
ENEA	European Nuclear Energy Agency of the Organisation for Economic Co-operation and Development
FAO	Food and Agriculture Organization of the United Nations
IAEA	International Atomic Energy Agency
IANEC	Inter-American Nuclear Energy Commission (of the Organization of American States)
ICRP	International Commission on Radiological Protection
IHD	International Hydrological Decade
ILO	International Labour Organisation
OAU	Organisation of African Unity
UNDP/TA	United Nations Development Programme/Technical Assistance
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 1966 to 30 June 1967.

2. During the year developments have taken place that may have a great influence on the scope and character of the Agency's work.

3. The Treaty for the Prohibition of Nuclear Weapons in Latin America, which was approved by 21 Latin American States on 14 February 1967, provides for the application of Agency safeguards to all atomic energy activities in the countries for which the Treaty comes into force, and foresees other roles for the Agency which would require consideration by the Board at the appropriate time. In the past year, the number of countries that have accepted Agency safeguards has increased from 23 to 27, and the system itself has been considerably developed. The number of reactors under Agency safeguards has increased to 61.

4. In accordance with the General Conference's Resolution GC(X)/RES/217 on a review of the Agency's activities, the Board has made a systematic review of these activities and of comments by Member States in the matter of finding ways and means of increasing the Agency's assistance to developing countries. Certain recommendations in this respect are presented separately to the General Conference [2], and the results of the review will be taken into account when drawing up the next Long-Term Programme of the Agency.

5. The sustained growth of nuclear power in the industrial countries and in some developing countries has required increased emphasis on the study of practical problems, e.g. siting, engineering and economic evaluations of projects. The Agency also continues to follow closely the development of advanced concepts such as breeder reactors, and it devotes expanded efforts to studies of fuel cycles.

6. The rapid progress being made in the industrial countries towards the complete mechanization of means for disseminating nuclear information and the need to ensure that other Member States benefit as fully as possible from these developments has led to plans for an International Nuclear Information System which would be co-ordinated and partially operated by the Agency.

7. An independent review of the work of the Joint FAO/IAEA Division of Atomic Energy in Food and Agriculture, carried out by eminent scientists has shown the need for increasing the financial contribution of the two organizations in order to expand the work in this field, and stressed the benefits that could be derived by Member States from the application of nuclear techniques to a wide range of activities in food and agriculture. Similar independent reviews of the work of the Agency's laboratories at Headquarters and Seibersdorf and of the International Laboratory of Marine Radioactivity in Monaco have endorsed the usefulness of these activities and the recommendations given will be taken into account in future programmes. The Board has also authorized the Director General to conclude a new agreement with the Italian Government for the International Centre for Theoretical Physics at Trieste.

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

[2] GC(XI)/362.

TECHNICAL ASSISTANCE AND TRAINING

(a) General

8. As in previous years a detailed report on the technical assistance provided by the Agency in 1966 is being submitted separately. [3] The present chapter draws attention to certain aspects and trends of the programme in 1966-67.

9. Some progress has been made in integrated country programming and, in general, co-ordinated requests for all three elements (experts, equipment, fellowships) are being submitted together as part of a country programme. This has permitted a more effective evaluation. Further steps have been taken to consolidate this system with the result that programming procedures are being improved, and a co-ordination between component parts of the programme is being achieved.

(b) Technical assistance

10. The 1967 programme of technical assistance from both the Agency's own resources and the UNDP/TA Component provides for the services of 136 experts to spend 847 man-months on field assignments and equipment to a value of $631 954; this aid will be spread over 48 countries.

11. Under the Agency's programme in 1967, requests were submitted to a value of $2.6 million, but a total of only $975 000 was approved. $597 000 will be spent on experts' services (326 man-months) and $378 000 on equipment. Although there was some improvement in pledges towards the 1967 target, the estimated likely availability is only 70% of the $2 million target, which has remained constant in spite of increasing costs since 1962. In 1959, it was possible to meet 89.6% of the requests submitted; in 1967 funds will be available for only 37% of the expressed need. The result is a gradual reduction in the percentage of technical assistance requests which can be met. This reduction is accentuated as the number of requesting countries increases. The lack of resources available to this programme continued to cause concern.

12. Table I below shows the respective percentage of assistance provided, over the period 1958-1966, in the form of experts, equipment and fellowships, excluding Special Fund projects, for different fields of activity. In 1966 alone, experts were provided free of charge by Canada (2), Sweden (1), the United Kingdom (4) and the United States (11).

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[3] GC(XI)/INF/93.

Table I

Technical assistance over the period 1958-66
(1966 percentages are shown in parentheses as an indication of the current trend)

Field of activity	Experts %	Equipment %	Fellowships %
General development in nuclear energy	2 (13)	4 (2)	1 (8)
Nuclear physics	18 (17)	19 (7)	22 (24)
Nuclear chemistry	10 (5)	8 (9)	11 (4)
Prospecting, mining and processing of nuclear materials	9 (3)	7 (3)	5 (2)
Nuclear engineering and technology	16 (17)	17 (22)	22 (17)
Application of isotopes and radiation in agriculture	14 (12)	15 (14)	8 (11)
Application of isotopes and radiation in medicine	11 (15)	12 (21)	11 (13)
Application of isotopes and radiation in biology	4 (5)	4 (8)	8 (7)
Application of isotopes and radiation in other fields	5 (8)	7 (9)	4 (10)
Safety in nuclear energy	11 (5)	7 (5)	8 (4)

13. Among the requests for 1967 under the Agency's programme, there were several for the extension of existing assignments, showing that projects are being consolidated rather than initiated.

(c) Training

14. A total of 283 fellowships (Types I, II, and UNDP/TA) were awarded during 1966: of these, 46 were extensions and 237 were new awards; in previous years extensions constituted 15-25% of the total awards. Table II shows the number of nominations received and awards granted for each of the past nine years. A list of fellowships offered or provided free of charge by Member States in 1966 is given in Annex II.

Table II

Fellowships

Year	Nominations received	Awards granted
1958	287	161
1959	577	296
1960	649	385
1961	648	295
1962	588	384
1963	580	293
1964	565	320
1965	550	271
1966	489	283

15. In addition, two awards in 1963, 21 in 1964, 14 in 1965 and 22 in 1966 were financed under Special Fund auspices. It is anticipated that the fellowship programme will continue at the present level for some years with year to year fluctuations due to UNDP/TA biennial programmes and Special Fund projects.

16. In the light of the resolution on education and training adopted by the General Conference at its tenth regular session (GC(X)/RES/215), close co-operation has been maintained with ILO and UNESCO, particularly concerning the training of technicians and the teaching of nuclear sciences in developing countries.

17. Table III at the end of this section lists the 11 international or regional training courses that were organized in 11 different countries, and attended by 209 foreign trainees in the period under review. Six of these courses were financed under UNDP/TA.

18. The study tour was the first of this type of training to be undertaken by the Agency. Participants from 15 Member States visited the Soviet Union, the United Kingdom, France and the Czechoslovak Socialist Republic during a tour lasting eight weeks. They were able to see a wide range of radioisotope techniques applied in many different industries. A separate report on this tour is being issued, which contains information of value to all Member States.

19. During the period covered by the report, ten scientists from six countries started their scientific visits, and one began training under a research grant. In 1966, the Agency assigned 21 visiting professors to developing countries.

20. The Agency has continued to support the activities of the Middle Eastern Regional Radioisotope Centre for the Arab Countries in Cairo. A training course on radiation protection and nuclear instrumentation was held at the Centre from 10 September to 3 November 1966 and was attended by 15 participants from four countries in the region. In 1967, one course will be held at the Centre of ten weeks' formal training to be followed by a longer period of practical training. The number of trainees will be about 20.

(d) Special Fund

21. Two Special Fund projects for which the Agency acted as Executing Agency - one on nuclear research and training in agriculture in Yugoslavia, and a pre-investment study on power, including nuclear power, in Luzon in the Philippines - were completed in 1966. Two other projects - one in Central America on the eradication of the Mediterranean fruit fly, and one in Turkey on radiation disinfestation of grain - are at present being executed by the Agency for the Special Fund. [4]

[4] See also document GC(X)/330, para. 33.

Table III

International and regional training courses

Title	Place and dates	Participation[a/]	Lecturers	
			Outside	Agency's staff
International advanced summer school in reactor physics	Sandefjord, Norway 22 August to 2 September 1966	40 (Austria, Belgium, Byelorussian Soviet Socialist Republic, Canada, China, Czechoslovak Socialist Republic, Denmark, Finland, France, Federal Republic of Germany, Greece, Hungary, India, Israel, Italy, Japan, Pakistan, Poland, Romania, Sweden, Switzerland, Turkey, Ukrainian Soviet Socialist Republic, United Kingdom, Union of Soviet Socialist Republics, Venezuela and Yugoslavia)	8	1
Study tour on the use of radio-isotopes and radiation in industry[b/]	Czechoslovak Socialist Republic, France, United Kingdom and Union of Soviet Socialist Republics 28 August to 3 November 1966	15 (Argentina, Bulgaria, Colombia, Greece, Hungary, India, Iraq, Israel, Mexico, Pakistan, Philippines, Poland, Thailand, United Arab Republic and Yugoslavia)	-	2
International survey course on economic and technical aspects of nuclear power	Agency Headquarters 5 to 17 September 1966	40 (Argentina, Belgium, Bulgaria, Chile, China, Czechoslovak Socialist Republic, Denmark, Federal Republic of Germany, Greece, Hungary, India, Indonesia, Israel, Italy, Japan, Republic of Korea, Kuwait, Mexico, Netherlands, New Zealand, Nigeria, Pakistan, Philippines, Romania, South Africa, Spain, Switzerland, Syrian Arab Republic, Thailand, Tunisia, Turkey, and Yugoslavia)	21	9

Title	Place and dates	Participation[a]	Lecturers	
			Outside	Agency's staff
International training course in radiobiology	Vinca, Yugoslavia 12 September to 4 November 1966	18 (Austria, Bulgaria, Chile, Cuba, Czechoslovak Socialist Republic, Hungary, India, Italy, Japan, Spain, Sweden, Switzerland, Syrian Arab Republic, Turkey and Venezuela)	3	1
Regional training course on general radioisotope techniques[b]	Kinshasa, Democratic Republic of the Congo 21 November to 16 December 1966	12 (Ethiopia, Ivory Coast, Kenya, Madagascar, Mauritius, Nigeria, Sierra Leone, Uganda and Zambia)	1	-
Inter-regional training course on the use of radioisotopes in soil and plant investigation[b]	Manila, Philippines 3 October to 25 November 1966	12 (Cambodia, China, India, Iran, Israel, Pakistan, Syrian Arab Republic, Thailand and United Arab Republic)	3	1
Training course on the maintenance and repair of nuclear electronic equipment[b]	Rio de Janeiro, Brazil 3 October to 23 December 1966	9 (Chile, Ecuador, Paraguay, Peru, Uruguay and Venezuela)	2	-
Regional training course on the use of radioisotopes in industry[b]	Mexico City 7 November to 3 December 1966	11 (Brazil, Chile, Colombia, Ecuador, Guatemala, Paraguay, Peru and Venezuela)	3	3
Inter-regional training course on the application of isotope techniques in hydrology[b]	Turkey 18 April to 26 May 1967	12 (Bulgaria, China, Democratic Republic of the Congo, India, Indonesia, Philippines, Poland, Saudi Arabia, Sudan, Thailand)	5	3
International training course on radiation biology	Israel 22 May to 30 June 1967[c]	20 (Austria, Bulgaria, Chile, China, Czechoslovak Socialist Republic, Guatemala, Hungary, India, Japan, Kenya, Mexico, Peru, Philippines, Romania, Spain, Thailand, Turkey, Venezuela, Viet-Nam, Yugoslavia)	3	1

Title	Place and dates	Participation[a/]	Lecturers	
			Outside	Agency's staff
International training course on food irradiation technology and techniques	United States of America 18 June to 11 August 1967	20 (Argentina, Australia, Brazil, Bulgaria, Chile, China, Czechoslovak Socialist Republic, Greece, India, Iran, Israel, Italy, New Zealand, Peru, Philippines, Romania, Spain, Thailand, Turkey, Venezuela)	-	1

a/ Local participants not included.

b/ Financed under UNDP/TA.

c/ The course ended on 7 June.

NUCLEAR POWER AND REACTORS

22. In almost all industrial and in a few developing countries the number and capacity of nuclear power plants on order or being built has continued to grow rapidly. At the end of 1966, 8700 MW(e) of capacity was in operation, during the year new orders amounted to about 23 000 MW(e) and during the early months of 1967 the increase in new orders has continued.[5] The Agency's programme is therefore laying more stress on practical service to Member States during the early stages of a nuclear power project (economic studies, siting, safety, bid evaluation), on problems and economics of fuel supply, and on improvements in the fuel cycle economy of existing systems. Looking to the future, the Agency is promoting exchange of information on advanced converter and breeder reactors and on new experimental means of power generation.

(a) Economic and technical aspects of nuclear power

23. The detailed study of power prospects, including nuclear power, on Luzon Island in the Philippines, has been completed and published.[6] It concludes that the Philippines will have to import fuel to meet the needs of the Luzon grid and that even under somewhat adverse conditions (16% annual charge and a 12% fall in the present cost of oil without duties) a 300-MW(e) nuclear plant would be competitive. The study therefore recommends a 1000-MW(e) programme consisting of three units, and foresees that by 1979 the lower running cost of nuclear power would have offset the higher initial investment and would bring an annual saving of about $14 million.

24. The growing interest of developing countries in nuclear power prospects was also evident in the large attendance (55 applicants accepted) at an international survey course on economic and technical aspects of nuclear power held by the Agency in September 1966. The special regional interest of countries in Asia and the Far East was also obvious at a study group meeting on problems and prospects of nuclear power applications in developing countries, held in Manila in October 1966, which attracted 45 participants from nine countries in the region.

25. Technical questions of topical interest were dealt with at three scientific meetings. A panel on recurring inspections of reactor steel pressure vessels, held in Pilsen, Czechoslovak Socialist Republic, in October 1966, reviewed the problems of inspection that will arise in the rapidly increasing number of nuclear power reactors, which are or will be equipped with steel pressure vessels. A symposium on alkali metal coolants, in Vienna in November 1966, reviewed experience with this promising technique for cooling breeder and other high-power density reactors and the problems that arise in the use of these highly corrosive materials. It emphasized the need for the study of alkali metal-water reactions. A panel in Vienna in April 1967 reviewed the latest methods of predicting burn-up and the outstanding problems in this subject of great importance to fuel cycle costing.

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

[6] Pre-Investment Study on Power including Nuclear Power in Luzon, Republic of the Philippines. General Report. UNDP/IAEA. June 1966.

(b) Nuclear fuels

26. In view of the reviving demand for source materials, the Agency and ENEA are bringing up to date the study on "World Uranium and Thorium Resources" published by ENEA in 1965. The first meeting of a joint Agency/ENEA working party took place in June 1967. An Agency working group on thorium utilization which met for the first time in December 1966 concluded that the potentially lower generating costs and high fuel efficiency of advanced thorium reactor types could assure them a place in the future nuclear power programmes.

27. Interest in the problems and possibilities of using the plutonium now being produced in nuclear power plants was evident in the unusually heavy attendance at the symposium on the use of plutonium as a reactor fuel, held in Brussels in March 1967. This provided a comprehensive review of the technology of fabricating and reprocessing such fuels as well as the problems of economics of plutonium fuels.

(c) Supply of nuclear fuels

28. The Board gave its approval for the supply of nuclear fuel through the Agency as indicated in Table IV below.

Table IV

Supply of nuclear fuel

State	Supply	Project
Iran	5585 g uranium (93% enriched), two fission chamber tubes, plutonium-beryllium neutron source	5-MW Teheran research reactor (fuel elements)
Mexico	2530 kg natural uranium 5-curie plutonium-beryllium neutron source	Sub-critical training assembly at the Instituto de Ciencias Autonomo de Zacatecas (fuel elements)
Norway	1443 kg uranium dioxide (3.4% enriched)	NORA (fuel elements)
Pakistan	4445 g uranium (90% enriched)	PINSTECH Reactor at Islamabad (fuel elements)
Philippines	4538 g uranium (93% enriched)	PRR-1 (fuel elements)
Spain	1156 g uranium (93.5% enriched)	CORAL-1 zero energy fast critical assembly (fuel elements)

29. The special fissionable material to the value of $50 000 granted by the United States for 1966 was allocated as set forth in Table V below.

Table V

Allocation of special fissionable material granted by the United States for 1966

State	Supply	Value
Finland	1850 g uranium (20% enriched)	$4 166
India	80 g plutonium	$3 440
Mexico	80 g plutonium	$3 440
Philippines	3142 g uranium (93% enriched)	$35 153
Turkey	80 g plutonium	$3 440

(d) Reactor siting and safety

30. For three of the projects mentioned in Table IV above, namely in Iran, Pakistan and the Philippines, the Agency reviewed health and safety measures applicable to the project. For the CORAL-1 reactor in Spain, an advisory mission on reactor safety was convened to study the safety aspects of the design, testing and operation of the reactor.

31. In April 1967 a symposium was held to review the problems of reactor siting and the associated topic of containment. A panel in Tokyo in June 1967 dealt with the special problems of aseismic design, i.e. of designing and testing reactors so as to ensure that they will withstand the effects of an earthquake.

(e) Reactor research

32. In the Agency's programme for promoting international co-operation in reactor research, the joint India/Philippines/Agency programme [7] was expanded by completing a second crystal spectrometer; the NORA project on the physics of light- and heavy-water-moderated lattices fuelled with uranium dioxide was extended for a further year; and the Norway/Poland/Yugoslavia (NPY) project on reactor physics [8] which began in 1964 was extended for three years.

33. To promote the exchange of information about special techniques, the Agency held a panel in July 1966 at Dubna, Soviet Union, on the research applications of repetitively pulsed reactors and boosters, which are of particular promise in research because of their ability to generate pulses of exceptionally high neutron flux at a relatively low cost. As a result of a panel in Vienna in November 1966 on in-pile dosimetry, the Agency will publish a manual on "Determination of Absorbed Dose in Reactors".

(f) Information

34. The sixth volume of the Directory of Nuclear Reactors published in July 1966, brings the total number of reactors covered by this series to 368; it is supplemented by a world map showing the location of nuclear power reactors in Member States. The first edition of the Reactor Card Index was completed in October 1966 and now covers 803 reactors, including some at a very early stage of design. The information collected for these publications will be computerised and made available on magnetic tapes.

[7] INFCIRC/56.

[8] INFCIRC/55.

(g) Nuclear desalination

35. New developments will bring nearer the stage when reliable information will be available on the cost of desalted water and the practical problems of operating large desalting equipment in conjunction with a reactor. Such developments are the decision to build a dual-purpose plant in Southern California, United States, to produce 190 000 m^3 of fresh water a day and 1600 MW of electricity, and the announcement of the Soviet Union of plans to construct two 350-MW(e) nuclear reactors combined with a 380 000 m^3/day desalting plant in the Don basin industrial area of the Ukrainian Soviet Socialist Republic. The main building of the fast-breeder dual-purpose plant at Chevchenko on the Caspian Sea, Soviet Union, which will provide 150 MW(e) and 120 000 m^3/day of fresh water, is nearly completed.

36. The Agency has continued to follow the studies being made in Greece, Israel, Tunisia and the United Arab Republic of dual-purpose nuclear plants, and to take part in the joint Agency/Mexico/United States feasibility study of a large dual-purpose plant near the head of the Gulf of California. Following a mission to Peru and the Antofagasta region of Northern Chile, it has also issued a report on water and power problems including the prospects for nuclear desalination in the area. A detailed engineering feasibility study will be needed before any definitive conclusions on the relative economics of possible alternatives for water and power supply can be drawn.

37. In the Agency's series of meetings on nuclear desalting, a panel held in November 1966 discussed the suitability of various reactors for single- or dual- purpose desalting applications and the means of varying the ratio of water to power, so as to satisfy different local conditions and needs.

(h) Advanced systems of power generation

38. A large symposium on magnetohydrodynamic electrical power generation held jointly with ENEA at Salzburg in July 1966, reviewed the progress made towards the development of MHD generators. In view of the worldwide interest in this subject, a Liaison Group on MHD, originally established by ENEA, was re-organized as a joint Agency/ENEA Group in April 1967.

ISOTOPES AND RADIATION SOURCES

(a) Food and agriculture

(i) General

39. During the year under review an Ad hoc committee favourably reviewed the activities of the Joint FAO/IAEA Division and revised arrangements came into force providing for its continuance. The division is to be known as the "Joint FAO/IAEA Division of Atomic Energy in Food and Agriculture".

40. The cost-free research co-operation agreement programmes in food and agriculture have been extended during the past year, so that cost-free agreements represent about one third of all contractual arrangements in food and agriculture. The annual expenditure under the remaining two thirds of the programme is now approximately $180 000.

Table VI

Co-ordinated programmes in food and agriculture in which cost-free research agreements form a major part

Research programme	Countries in which co-ordinated programmes in food and agriculture are being carried out
Production and use of induced mutations in plant breeding	Argentina, France, Federal Republic of Germany (2), India, Italy (2), Japan, Norway[a/], Sweden (2), United States of America (4), Yugoslavia
Isotopes and radiation in control of parasitic diseases	Czechoslovak Socialist Republic, Denmark, Hungary, Italy, United Kingdom (2), United States of America, Yugoslavia
Microbiological aspects of food preservation by irradiation	Australia, Hungary, Japan (1 + 1[a/]), Sweden
Plant nutrient supply and movement	Australia[a/], Belgium, Denmark, Hungary, India[a/], Japan[a/], Netherlands, Poland

a/ These contracts involve research supported by the Agency.

(ii) Soil fertility and irrigation

41. Existing programmes dealing with soil fertility and irrigation were continued, and a new programme on the use of isotopes to study nutritional requirements of tree crops was initiated. As tree crops are of major importance to many developing countries in which cereals are not of great importance, it is hoped that the programme will be of particular interest to them. Ceylon, Ghana, Kenya, Nigeria, the Philippines, Spain and Tunisia are at present participating.

42. Symposia were held on the use of isotopes in plant nutrition and physiology (Vienna, September 1966) and on the use of isotopes and radiation techniques in soil physics and irrigation studies (Istanbul, June 1967). To help meet the need for trained technicians in this field, the Agency and FAO held an inter-regional training course on the use of radio-isotopes in soil and plant investigations in Manila, October-November 1966.

(iii) Radiation entomology

43. Work at the Agency's laboratory in entomology has led to cheaper rearing media for the Mediterranean fruit fly. This development is being utilized in the Special Fund project for the eradication of the Mediterranean fruit fly in Central America where it will result in a saving of approximately $100 000 in the cost of the project. Under this project a maximum of 50 million flies can be produced per week, and flies sterilized by irradiation are being released in selected areas. Increasing attention is being given to the possible use of the sterile-male technique for controlling livestock insect pests.

44. The rearing of the olive fly on artificial media has now become possible; however it is at present much less productive than in the case of the Mediterranean fruit fly. In addition, studies are now progressing with respect to field release and accompanying studies of the population in island situations. Expansion of the work on the olive fly is continuing with prospects of larger field releases of sterile males.

(iv) Pesticide residues and food protection

45. The estimation of dietary levels of man-made and naturally occurring radionuclides has continued and data prepared on this subject was used by UNSCEAR in the preparation of its 1966 report on the effects of atomic radiation.

46. Close collaboration has been maintained with FAO and the FAO/WHO Working Party on Pesticide Residues, which met at Geneva in November 1966, in order to obtain an assessment of the possible application of radiation and radioisotopes to studies on pesticide residues. An expert meeting on mercury contamination in man and his environment met during the Agency symposium on nuclear activation techniques in the life sciences, which was held in Amsterdam in May 1967.

(v) Plant breeding and genetics

47. Some of the wheat mutants tested under the FAO/Agency Uniform Regional Trials in nine countries of North Africa, the Near and Middle East outyielded all local and common check varieties included in the trials. At the co-ordination meeting of the Rice Mutation Breeding Programme reports of promising mutant lines of rice were given. Mutant rice lines have shown improvement with regard to earliness, straw strength, disease resistance, yield and quality.

48. Standardized computer-printed field books were used in the Uniform Regional Trials of mutant rice and wheat. The data are processed by computer. The Joint Division is co-operating with FAO and the International Biological Programme in establishing standard formats for recording mutant and other germ source data in preparation for world records of germ plasma collections. Steps are also being taken to mechanize data records of all kinds of agronomic experiments with isotopes and radiation for computer processing.

49. Work is also being done to standardize methods of neutron exposure of seeds and certain other biological material and thereby improve the effectiveness and comparability of such neutron treatments.

(vi) Animal production and disease control

50. A co-ordinated programme on the use of isotopes and radiation on the aetiology, effects and control of parasitic animal diseases has been started. It will focus attention on the unique way of producing vaccines against certain of these diseases by means of radiation attenuation of worms, and also the use of isotopes in studies of immunology and pathology. A seminar reviewed the use of radioisotopes and radiation in dairy science and technology at Vienna in July 1966.

(vii) Food irradiation

51. Continued Agency support has been given to the International Programme on Irradiation of Fruit and Fruit Juices, in which the Agency collaborates with ENEA and the Austrian Studiengesellschaft für Atomenergie [9]. A panel on preservation of fruits and vegetables by irradiation held in August 1966 stated the importance of preventing post-harvest deterioration of fruits and vegetables. It stressed the need for further work on the extension of the useful storage life by irradiation, and on the mechanism of radiation-induced changes in tropical fruits.

52. A notable feature in the field of food irradiation has been the increasing number of requests for special missions to conduct on-the-spot reviews and investigations of possible applications. During the year, Iceland, India, Pakistan, Peru and Thailand were visited for this purpose. In Iceland the possibilities for implementation of a pilot plant for the irradiation of fish were investigated. In India food preservation problems were discussed. In Thailand the possible implementation of a multi-purpose pilot plant for the irradiation of fresh fish, rice and bananas has been investigated. In Pakistan, several proposals submitted to the Pakistan Atomic Energy Commission for the construction of food irradiation pilot plants have been evaluated. Finally, the possible application of the irradiation of fish-meal and cotton-seed meal and the irradiation of fresh fish and potatoes were studied.

(b) Nuclear medicine and radiation biology

(i) Nuclear medicine

53. The programme has continued to concentrate on the physical aspects of nuclear medicine and to support research on diseases that affect particularly the tropical and subtropical areas of the world, such as parasitic infections, deficiency diseases and tropical anaemias. The distribution of research contracts is shown in Table VII below.

Table VII

Distribution of medical isotope research contracts
by subject and country

Research topic	Countries in which research is conducted with Agency support
Anaemia	Ecuador, Ghana, Greece, Iraq, Japan, Madagascar, Republic of Korea (2), Lebanon, Nigeria, Romania, South Africa, United Arab Republic
Goitre	Austria, Belgium, Democratic Republic of Congo, Bolivia, Bulgaria, Iraq, Israel, Japan, New Zealand, Spain, Turkey, United Arab Republic
Parasitology	Iraq, Japan, Philippines, United Arab Republic
Malnutrition	Argentina[a/], Brazil[a/], Chile, Democratic Republic of Congo, Guatemala, India[a/], Israel[a/] [b/], Jamaica[a/], Nigeria, Pakistan, Philippines[a/], South Africa[a/], United Arab Republic[a/]

a/ Part of a co-ordinated research programme on the use of radioisotopes in the study of malnutrition in tropical and subtropical regions.

b/ Cost-free research agreement.

54. A symposium in Amsterdam in May 1967, on nuclear activation techniques in the life sciences reviewed the applications of activation analyses in biology, medicine and human ecology, and showed that new refinements are likely to lead to a great increase in future applications of this technique.

[9] INFCIRC/64.

55. Other developments in the programme include:

(a) A decision to terminate Agency financial support of studies on radium-226 and strontium-90 toxicity in humans after 1967, leaving further work to local support;

(b) Preparations which have been made to compare the relative performance of standard scanners and scintillation cameras of different manufacture now widely used for delineating the distribution of radioactivity in organs and tumours;

(c) An annotated bibliography of books on the use of radioisotopes in medicine published between 1955-1966 which has been prepared and will be kept up to date; and

(d) The participation of the Agency in a Pan-American Health Organization field experiment in the Peruvian Andes on the use of iodized oil for the prevention of endemic goitre.

(ii) Radiation biology

56. To enhance its practical benefits, the Agency's programme in radiation biology now concentrates on:

(a) Studies defining the basis for radiosensitivity of cells and their capacity to repair injuries sustained. This is directly relevant to problems of radiation protection; and

(b) Studies directed towards practical biomedical applications of radiological principles - such as radiosterilization.

57. The programme is carried out chiefly by research contracts and agreements of which the distribution is shown in Table VIII below.

Table VIII

Distribution of radiation biology research contracts by subject and country

Research topic	Countries in which research is conducted with Agency support
Mechanisms of radiation injury (somatic and genetic)	Argentina (2), Australia, Belgium, Bulgaria (2), Czechoslovak Socialist Republic, Ecuador, Hungary (2), Republic of Korea, Netherlands (3), Poland, Turkey
Modification of radiation injury	Belgium, Italy, Japan, Spain, United Kingdom
Radiobiological applications	Belgium, Czechoslovak Socialist Republic, Denmark, Federal Republic of Germany, Hungary (2), Republic of Korea (2), Turkey

In addition, cost-free research co-operation agreements have been initiated in the radiosterilization of medical products and biological tissue with five Member States.

58. Two panels were held on radiation injury. The first on the effects of radiation on reproductive cell formation (meiosis), especially on the genetic consequences of repeated low-level radiation exposures, and the second on radiation and control of the immune response. This is important for understanding how far the technique of transplanting tissues can be used

as a treatment for serious radiation exposures. Training courses in Israel and Yugoslavia were held with a view to enabling young scientists from developing countries to take a greater part in radiobiological research.

59. To promote the safe use of radiation for sterilizing biomedical products, an Agency panel formulated an International Code of Practice for the manufacturers of such products. A symposium on the radiosterilization of medical products reviewed an extension of this technique to pharmaceuticals, medical devices, bio-products like hormones and sera, and tissues like bones and arteries for grafting purposes. A Bone Bank has been established in Vienna with the Agency's help; this may enable the Agency to assist in the clinical application of radiation for this purpose in other countries. A cost-free research programme has been started to explore the feasibility of producing a snake-bite serum or vaccine with a broad spectrum of application.

(iii) Radiation dosimetry

60. The Agency's programme in radiation dosimetry, which has been considerably strengthened, deals chiefly with problems of measuring ionizing radiation used for medical and biological purposes, especially radiation therapy. A second panel on biophysical aspects of radiation quality, which was held in Vienna in April 1967, reviewed the Agency's co-ordinated research programme relating to the biological effects of different types of radiation, a subject of importance for reactor safety problems, dosimetry radiotherapy and radiosterilization. A symposium in October 1966 on solid state and chemical radiation dosimetry in medicine and biology studied a new theory and techniques for measuring radiation dose for medical and biological purposes, pointed to the need for international agreement on standards for absorbed dose, and once more underlined the inherent limitations of classical methods for measuring radiation when applied in biology.

61. A postal service, to help cobalt-60 teletherapy centres in developing countries to calibrate their machines, has been started. The service involves the use of thermoluminescent lithium fluoride powder dosimeters and has been started in the Far East and South East Asia after preparatory testing by 20 radiotherapy centres in advanced countries. The Agency is also compiling a computerised register of radioisotope teletherapy installations and other high-energy radiation equipment used in therapy throughout the world.

(c) Hydrology

62. The world-wide survey of tritium, oxygen-18 and deuterium contained in precipitation, which started in 1961, is providing valuable data to hydrologists for studying the rates of movement and storage of water in the hydrological cycle. A complementary survey within the programme of the IHD has been started to measure the discharge of tritium from the continents to the oceans. Monthly samples from the major rivers of the world are being analysed for their isotopic content.

63. The Vienna and the Modry Dul basins in Austria and the Czechoslovak Socialist Republic have been designated as "representative basins" for concentrated study during the IHD. In the Vienna basin, the isotope hydrological study has now been broadened with the object of calculating the water balance for the entire basin on the basis of tritium content of streams as well as of groundwater.

64. Other programmes of broad interest now include:

(a) Two programmes of ocean sampling of radioactive and stable isotopes involving seven weather ships and the Monaco Laboratory;

(b) A basic project to show the relationship of precipitation to the isotopic composition of infiltrating water, involving six stations in the United States and Western Europe;

(c) A symposium on the use of isotopes in hydrology in Vienna in November 1966, which provided an up-to-date review of the current use of isotope techniques, and a symposium in Monaco in March 1967 on radioactive data and methods of low-level counting;

(d) A panel in November 1966 on measurements of natural concentrations of deuterium and oxygen-18, which showed that there is an urgent need for the preparation and distribution of basic standards of these isotopes; and

(e) An international training course on the applications of isotope techniques in hydrology, in Ankara, in April/May 1967. The Secretariat also provided lecturers who took part in several other training courses sponsored by UNESCO.

65. Work of benefit to individual Member States in applying isotope hydrological techniques to water development studies has continued in Jamaica and Jordan. New studies have been started in the Niger and Spain. The Agency has helped national studies in Austria, Greece, Kuwait, Mexico, Saudi Arabia, Spain and Thailand by carrying out isotope analyses in the Agency's laboratories.

(d) Industry

66. A symposium on the applications of radioactive tracers in industry and geophysics was held in Prague in November 1966. Other projects undertaken during the year have included:

(a) Preparation, in co-operation with other international organizations, of standards for the safety of radioisotope power generators;

(b) Co-ordinated research and development of neutron moisture gauges which are now being widely used in civil engineering, agriculture and hydrology;

(c) A study tour by means of which experts from 15 developing countries visited the Czechoslovak Socialist Republic, France, the Soviet Union and the United Kingdom to examine the wide range of isotope techniques in those countries;

(d) A training course on radioisotope applications in industry in Mexico City; and

(e) Publication of a bibliography on radioisotope instruments in industry and geophysics [10].

[10] Bibliographical Series No. 20, 1966.

67. The trend in the programme is towards activities which will help developing countries to apply the standards and techniques that have been developed by the Agency and advanced centres in recent years. This help includes preparing practical manuals for guidance, organizing regional study groups and training courses and giving an increasing amount of ad hoc advice on request; as in the past, extensive use has been made of international panels of experts to draft standards and manuals, and to advise on programmes.

68. The Agency's basic standards for radiation protection have been reviewed to take into account the latest recommendations of ICRP. Most international transport organizations have brought their regulations into line with the Agency's Transport Regulations of which a revised edition has been published, incorporating detailed standards for packaging large radioactive sources. The Secretariat is also studying standard package designs and packaging designs as well as the possibility of the Agency sponsoring centres that would undertake testing of packagings.

69. Work has begun on a code of practice on the safe operation of nuclear power plants, which it is expected will be completed by the end of 1967.

70. A symposium in September 1966 reviewed the problems of neutron monitoring for radiological protection, which remains one of the more complex protection topics involving difficulties with regard to unit of measurement as well as measuring techniques and instruments.

71. The Agency has also prepared the following practical guidebooks:

(a) Personnel dosimeter systems for external radiation exposures;

(b) The safe handling of radioisotopes in hydrology;

(c) The medical supervision of radiation workers (in collaboration with ILO and WHO);

(d) Respirators and protective clothing;

(e) The hazards evaluation of hot laboratories;

(f) Operational health physics data; and

(g) The design and equipment of hot radiochemical laboratories.

72. With a view to helping Member States to deal with the problems that would arise in the case of an accident, the Agency is:

(a) Continuing work together with WHO and FAO on a comprehensive manual on emergency planning for radiation accidents;

(b) Continuing to compile and distribute information collected by the three organizations on the help that Member States would be prepared to give in the case of an emergency; and

(c) Preparing for a regional training course on emergency planning and procedures to be held for countries in Asia and the Far East in September 1967.

73. The Agency is arranging for the distribution of abstracts of current or recent research on selected health physics topics; it is also reviewing the problems of inhalation risks from radioactive contamination and, together with WMO, the requirements for meteorological surveillance and the role of meteorology in siting and operating nuclear establishments.

74. To promote knowledge and studies of health physics problems in the region, the Agency and IANEC held a study group meeting in Buenos Aires in November 1966. It appears that it would be useful to hold similar meetings in Latin America at approximately two-year intervals.

75. A general review of the Agency's waste management programme made in January 1967 indicated that its main work should be to help developing countries to select waste management techniques suitable for their needs. The policy for research contracts and research co-ordination meetings should be modified correspondingly, and the activities in advisory services, training regional study groups and preparing technical guide books should continue and expand as required. The technology of managing low and intermediate wastes is sufficiently well developed to require only an occasional review or study of special problems, while the Agency's work on high-level wastes should be limited until the results of the work being done in the technically advanced countries are available.

76. The Agency has prepared a report on the economics of waste management, recommending an easily operated cost analysis system and a second report setting out the factors to be taken into account in selecting systems for treating and disposing of radioactive wastes.

77. Guidebooks and manuals have been prepared on methods of estimating radioactivity in solid packaged waste; on the treatment of concentrates from the processing of low- and intermediate-level wastes; on methods of reducing the volume of low-level solid waste and on the treatment of wastes by evaporation, chemical precipitation and ion exchange.

78. Shallow burial of waste in the ground is a safe and cheap method of disposal under suitable conditions, while deep burial of high-level waste is expensive and complex. These matters were reviewed by an Agency/ENEA symposium on the disposal of radioactive waste into the ground in May 1967.

79. The Agency continued to support research on the process of dispersal and release of radioactive materials into various environments as well as on economically sound processes for treating and fixing wastes, giving preference to studies relevant to small-scale operations. Attention has also been given to co-ordinating research on the treatment of aerosols and volatilization products from waste processing.

RESEARCH AND SERVICES IN PHYSICAL SCIENCES

(a) Physics

80. Most of the work has continued to be that of promoting exchange of information, of scientific contacts, and in some cases of co-ordinating research in selected topics in neutron, nuclear, solid-state and plasma physics.

81. The Agency's Nuclear Data Unit which is now one of the four worldwide compilation centres [11] and which has made further progress towards its objective of ensuring the fullest international exchange in computerized form of all available neutron cross-section information, has provided the scientific services for:

(a) The meetings of the International Nuclear Data Committee in Vienna and Moscow in October 1966 and May 1967 respectively; and

(b) The first worldwide international conference on nuclear data in Paris in October 1966.

82. In step with progress in the Secretariat's work to promote data exchange, it has been found timely to convert the International Nuclear Data Scientific Working Group into a permanent International Nuclear Data Committee. The Working Group has fulfilled its role as an essential catalyst in worldwide exchange of data; in its new form it will continue to advise the Secretariat on the work of the Nuclear Data Unit as well as to serve as an international forum for technical discussions and direct contacts between the main centres.

83. The International Centre for Theoretical Physics was established at Trieste in 1963 in order to foster, through training and research, the advancement of theoretical physics, with special regard to the needs of the developing countries. In February 1967 the Board decided that the activities of the Centre should continue for a further period of six years until the end of the academic year 1973-74, and in June it approved an appropriate agreement with the Italian Government.

84. Work at the Centre during the year has included a two-and-a-half months' course on advanced nuclear physics in which 102 participants from 28 [12] Member States took part, and lectures were given by 32 scientists; and continued research on high-energy and elementary particle physics.

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[11] The Brookhaven National Laboratory Center (United States), the ENEA Neutron Data Compilation Centre at Saclay (France), the Nuclear Data Information Centre in Obninsk (Soviet Union) and the Agency Nuclear Data Unit in Vienna.

[12] Albania, Argentina, Australia, Austria, Belgium, Bulgaria, Brazil, Canada, Czechoslovak Socialist Republic, Finland, France, Federal Republic of Germany, Greece, Hungary, India, Italy, Madagascar, Netherlands, Pakistan, Poland, Romania, South Africa, Syria, Turkey, Soviet Union, United Kingdom, United States and Yugoslavia.

85. For the current academic year, 27 fellowships have been awarded to students from 21 countries [13]. Most fellows took advantage of the post-graduate training courses offered by the Advanced School of Physics, operated by the Agency, UNESCO and the University of Trieste. Seventy-eight research workers from 26 [14] countries were appointed to join the staff of the Centre for periods of from one to twelve months. The Centre's research has been described in 72 publications distributed to some 500 scientific institutes throughout the world.

(b) Chemistry

86. Much of the Agency's programme in chemistry consisted of helping research reactor centres in developing countries to prepare or carry out radiation chemistry, radiochemistry and isotope production programmes. After a meeting on the subject, a report will be prepared on the application of major radiation sources, including nuclear reactors, to chemistry, which will also serve as a guide to developing countries in this field.

87. Another report drawn up by a panel in October 1966 gives the most recent data on plutonium (and mixed) oxides, and gives guidance on the chemistry of these compounds, which will be useful in fuel fabrication, reactor design and operation and reprocessing of irradiated fuel.

(c) Laboratories

88. The work done during 1966 at the Agency's laboratories at Seibersdorf and Headquarters and at the International Laboratory of Marine Radioactivity at Monaco is described in the fourth Annual Report on the Agency's Laboratory Activities. [15]

89. The activities of the Agency's laboratories, including the Monaco Laboratory, were reviewed by three independent committees of experts at the end of 1966. In broad terms their conclusions were:

(a) With regard to the Seibersdorf and the Headquarters laboratories, the ad hoc committee considered that they could make substantial contributions to peaceful nuclear energy programmes, both in developing countries and in advanced countries, in helping to solve scientific and technical problems of common interest to many nations which cannot be adequately solved by national organizations alone, or even by groups of organizations. It considered also that the training activities, in particular the fellowship programmes, were very valuable activities of the laboratories and should be continued at least at the same scale; and

(b) With regard to the Monaco Laboratory the committee considered that the activities of this laboratory should be continued on a broader basis. It emphasized the role that the laboratory could play in the development and assessment of methods and techniques in the analytical chemistry of trace elements in a marine environment. The committee also considered that the training role of the laboratory should be encouraged and extended.

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[13] Albania, Argentina, Brazil, Bulgaria, China, Federal Republic of Germany, Greece, Hungary, India, Indonesia, Israel, Italy, Nigeria, Pakistan, Poland, Romania, Spain, United Arab Republic, United Kingdom, Uruguay and Yugoslavia.

[14] Argentina, Austria, Brazil, Bulgaria, Czechoslovak Socialist Republic, France, Federal Republic of Germany, Hungary, India, Israel, Italy, Japan, Mexico, Nigeria, Pakistan, Poland, Romania, Spain, South Africa, Sweden, Switzerland, Syria, Soviet Union, United Kingdom, United States and Yugoslavia.

[15] IAEA Laboratory Activities, 4th Annual Report, Technical Reports Series No. 77.

(a) Documentation - International Nuclear Information System

90. The trend towards complete mechanization of information systems, the need to ensure that as many Members of the Agency as possible have access to machine-processed information, and the desirability of ensuring that regional and national developments are internationally co-ordinated, had led the Agency to consider plans for an International Nuclear Information System, which would integrate the main national and regional documentation centres and would be co-ordinated and partially operated by the Agency. Amongst the main recommendations of a Working Group on this subject, which met in December 1966, were that an immediate start be made on the study of input preparation for the system, that consideration be given to the suggestion to publish an International Nuclear Science Abstract Journal within the framework of the system, and that its financial implications be the subject of detailed study. These and other proposals will be further developed in the Budget for 1968 and in subsequent Programmes.

91. In the meantime, experience is being gained in the use of electronic data processing machines for documentation work. The Agency has developed a "Generalized Information Processing System (GIPSY)" to code bibliographic and other data for information retrieval, and the system is being adopted to use magnetic tapes of material included in "Nuclear Science Abstracts" published by the United States Atomic Energy Commission. The system is being regularly used in the computer preparation of the Agency's "List of References on Nuclear Energy" and "Nuclear Medicine" (a guide to recent literature) as well as for preparing various bibliographies.

92. Steps are being taken with a view to obtaining a third-generation computer having sufficient capacity to meet the various needs of the Agency, especially its Nuclear Data Unit.

(b) Scientific meetings

93. Table IX below gives comparative information for 1965 and 1966 in respect of conferences, symposia and seminars.

Table IX

Conferences, symposia and seminars

Item	1965	1966
Meetings	15	12
Participants	2161	1826
Countries taking part	49	59
Papers presented	829	784

94. The programme gave greater emphasis in 1966 to topics concerning nuclear power and life sciences. Further details about the 1966-67 programme are given in Annex VI.

(c) Publications

95. Scientific material published by the Agency in 1966 originated from the following sources:

(a) Proceedings (Agency conferences, symposia, seminars, panels) 60%;

(b) Reviews and monographs 10%;

(c) Safety series 8%;

(d) Directories 4%; and

(e) Miscellaneous documentation 18%.

96. The growing demand for Agency publications is shown by the fact that in 1966 42 000 copies were sold providing an income of $120 000 as compared to 35 000 copies with an income of $104 000 in 1965. Income from sales during the first half of 1967 is estimated to be about $65 000.

(d) Library

97. The library now holds 32 000 books, 90 000 reports and receives about 1100 periodicals.

SAFEGUARDS

98. As has already been mentioned in the Introduction, the Agency's safeguards activities have again increased in the past year as a result of the entry into force of several agreements and the approval by the Board of some new agreements. Some preliminary work has been done on a possible extension of the Agency's safeguards system to processing and fuel fabrication plants. Special weight has been given in the past year to the development of safeguards practices and methods for specific facilities. More stress has also been laid on research aimed at the eventual development of devices to improve and also to simplify safeguards techniques.

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

99. The Agency's Safeguards System (1965) foresees extension of the System to all types of principal nuclear facilities. After the provisional extension of the System to reprocessing plants the Agency is now involved in the application of safeguards to such a plant. It is expected that it will soon have to apply safeguards to several plants for fabricating nuclear material as well, and in June 1967 the Board accordingly established a working group of the whole Board to which it has entrusted the preparation of the additional provisions that are required. The Board has invited all Member States to communicate their views on this matter for consideration by the working group, and has also invited those Members that communicate views but are not serving on the Board to send observers to the working group's meetings.

(b) Notification of transfers of nuclear materials

100. The safeguards transfer agreements provide that the transfers under the inter-Governmental arrangements to which they pertain should be notified to the Agency. Following the intimation by the Resident Representative of the United States in April 1965 that his Government would notify to the Agency, semi-annually, all United States transfers of nuclear material under bilateral agreements with Governments and international organizations, the Government of Canada announced in September 1966 that it was willing to participate in a system of notifying international transfers of nuclear materials. Notifications so far received from the United States cover the period from 1 July 1964 through 30 June 1966, and the Canadian reports so far pertain to the first half of 1966. Informal consultations show that some other Governments favour the principle of notifications. Consultations are continuing.

(c) Implementation of Agency safeguards

101. As shown in Table XI at the end of this section, by 30 June 1967 the Board had approved a total of 34 safeguards agreements involving 27 States, as compared to 29 agreements with 23 Member States on 30 June 1966 [16]. The table includes five agreements that have not yet entered into force.

102. In the period under review three safeguards transfer agreements were approved regarding bilateral co-operation agreements between the United States on the one hand and Australia, Indonesia and Spain on the other hand. Project agreements approved during the period and involving Agency safeguards concern Iran, Norway, Pakistan, the Philippines, Spain and Viet-Nam. The project agreements for Iran, the Philippines, Spain and Viet-Nam pertain to fuel for reactors already covered by safeguards transfer agreements. The

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[16] For the purpose of these statistics a safeguards agreement is taken as any agreement to which the Agency is a party that specifies that safeguards are to be applied. This means that agreements expressly exempting from safeguards the material covered are not included, but agreements under which materials may be exempted later are included as long as exemption has not been granted.

conclusion of these project agreements therefore does not change the number of reactors under safeguards. Since the Norwegian and Pakistan projects are extensions in time and scope respectively of existing projects, these too leave the total number unaffected.

103. Once the safeguards agreements listed above have all come into force, they will cover the 61 reactor facilities listed in Table XII which is reproduced at the end of this section.

104. A list of reactor facilities covered by safeguards agreements does not in itself give the full picture of the safeguards operation. A large part of the material to which these agreements pertain is outside reactor facilities, at separate locations, and separately accounted for under the Agency's safeguards system. Such locations include commercial establishments using safeguarded material in research of pilot scale fabrication or processing, research and development installation and storage areas outside reactor facilities. Table X below gives the numbers of these separate accountability areas, excluding reactors, for each State where Agency safeguards are applied. It includes some which will arise under agreements not yet in force, because even though in the latter cases safeguards are not actually applied, the preparations for their application usually involve consultation and study by the Secretariat, and pre-operational visits relating to the facilities involved.

Table X

Separate accountability areas, excluding reactors, for each State where Agency safeguards are applied

Member State	Number of separate accountability areas
Argentina	2
Australia	2
Austria	1
Denmark	1
Finland	1
Israel	1
Japan	45
South Africa	1
Spain	3
United States of America	1
Yugoslavia	1
Total	59

105. The total number of principal nuclear facilities, research and development facilities and other separate accountability areas where Agency safeguards are applied is now 120.

106. The safeguards agreements so far approved by the Board now cover reactors of which the thermal capacity totals 3013 MW. By far the greatest part of this figure is accounted for by four power stations, in Japan, Spain, the United Kingdom and the United States. Most of the reactors newly added to the list are, however, research facilities of low power. Many of these are fuelled with highly enriched uranium, which means that the effort involved in safeguarding them is greater than the thermal capacity figure would indicate. However, as already indicated, reactors form only part of the safeguards work whereas the other principal nuclear facilities and installations under safeguards cannot be described in terms of thermal output. In the graph which is reproduced at the end of this section, therefore, although the curve representing thermal capacity of reactors covered by the Agency's safeguards agreements shows a continuous growth since 1963, it can at best give only a partial picture of the actual growth of the Agency's safeguards effort.

107. Preparations for the application of safeguards to chemical reprocessing plants have been a major feature of safeguards work in the past year. Pursuant to the agreement for the application of safeguards to four United States reactor facilities [17], safeguards will continue on produced material, i.e. plutonium, in the irradiated fuel from the Yankee Atomic Power Station when this is separated at the Nuclear Fuel Services plant, near Buffalo, N.Y. In preparation for the first operation of this kind - which is expected to last for four to seven weeks - a team of inspectors has been formed, several of whom come from other Departments of the Secretariat. This has required arranging a considerable training programme. Detailed procedures have been worked out for the practical implementation of safeguards. Some of the staff at the Agency's Laboratory have participated in these preparations and will be on the inspection team, and a small plutonium handling facility has been set up at Seibersdorf for the preparation of synthetic standards to be used during inspections; this will also analyse samples sent back from the Nuclear Fuel Services plant for purposes of independent verification.

108. During the past year 29 inspections were made in 11 Member States. [18] In addition, 13 pre-operational visits were made to nine Member States. [19] Whenever possible pre-operational visits were made in conjunction with inspection travel to the State concerned or to States in the same general area.

(d) Research and development programme

109. The shift from theoretical studies to the development of practical equipment and techniques has continued, and increased attention is given to work aimed at an improvement in the application of safeguards to existing facilities. The problems encountered are increased by such factors as the existence of a great variety of facility and fuel types, each requiring often very different safeguard techniques; the fact that most equipment should be used in field operations and should therefore be both easy to transport and adjustable; and the consideration that any safeguards device must be both tamper-proof and be so designed as not to hamper facility operations.

110. Development work now covers two areas, i.e. specific development directed at devising safeguards practices for particular facilities now, or soon to be, under safeguards, and general development. This in turn includes two categories: the determination of physical inventories of irradiated and unirradiated nuclear materials; and verification of the operational history of nuclear facilities.

111. The programme of technical development now being prepared will eventually lead to work on a wide spectrum of subjects, including both the destructive and non-destructive analysis of unirradiated as well as irradiated fuel; verification of integrated thermal power in nuclear reactors; verification of fuel movements through nuclear facilities; identification methods for fuel elements; and sealing techniques and theoretical analysis of uranium depletion and plutonium build-up in nuclear reactors of various types.

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[17] INFCIRC/57.

[18] In these figures an "inspection" is taken to be a single, distinct visit to a facility (including a research and development facility) made for the purpose of ascertaining that the terms of the relevant safeguards agreements are observed and about which a report is made. An inspection is counted as one, no matter whether it is made by more than one inspector, lasts a considerable time or is briefly interrupted; the determining factor is the single report.

[19] The term "pre-operational" visit is used to mean a visit to any State with the purpose of preparing for the safeguarding of material and facilities, made before the entry into force of the relevant agreement or the assumption by the Agency of safeguarding responsibility.

112. Research and development in safeguards is largely done through contracts with external organizations. In the period under review, contracts were placed with research establishments in Canada, the Czechoslovak Socialist Republic, France, the United Kingdom, the Soviet Union and the United States. Several others are in an advanced stage of preparation. Some work is done in the Agency's Laboratory.

113. Safeguards research and development require complex efforts, and every attempt is made to find the most fruitful approaches. Close contact with scientists outside the Agency has continued on possible work to develop safeguards techniques. The Governments of Canada, France, India, Japan, the Soviet Union, the United Kingdom and the United States have been invited to send one expert each to participate in a technical discussion to be held in August, on future trends of research and development for safeguards techniques and methods.

Table XI

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
Iran	UTRR Reactor	10 May 1967	
Japan	JRR-3	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
Philippines	PRR-1 Reactor	28 Sep 1966	88
Spain	Coral I Reactor	23 Jun 1967	
Uruguay	URR Reactor	24 Sep 1965	67
Viet-Nam	VNR-1 Reactor		
Yugoslavia	TRIGA II Reactor	4 Oct 1961	32
(Bilateral co-operation agreements between the indicated States)			
Transfer Agreements			
Argentina/USA		1 Mar 1966	79
Australia/USA		26 Sep 1966	91
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
Indonesia/USA			
Iran/USA			
Israel/USA		15 Jun 1966	84
Japan/USA		1 Nov 1963	47
Japan/UK			
Philippines/USA		24 Sep 1965	69
Portugal/USA		15 Dec 1965	77
South Africa/USA[a/]		8 Oct 1965	70
Spain/USA		9 Dec 1966	92
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		

a/ This Agreement, based on the Agency's Safeguards System (1961) set forth in document INFCIRC/26, will expire on 14 August 1967. In June 1967 the Board approved a new Transfer Agreement based on the Agency's Safeguards System (1965) set forth in documents INFCIRC/66 and GC(X)/INF/86.

Table XII

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	x	1
	RA-3/Argentine Reactor 3	Ezeiza	Pool-tank	5.00	x	1
Australia	HIFAR	Lucas Heights	Tank	10.00	x	3
	MOATA	Lucas Heights	Argonaut	.01	x	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
(Indonesia)	(TRIGA II/Bandung)	Bandung	Triga II	.25	x	0
Iran	UTRR	Teheran	Pool	5.00		2
Israel	IRR-1	Yavne	Pool	5.00	x	2
Japan	JRR-1/Japan Research Reactor 1	Tokai-mura	Aqu.-hom.	.05	x	0
	JRR-2/Japan Research Reactor 2	Tokai-mura	Tank	10.00	x	3
	JRR-3/Japan Research Reactor 3	Tokai-mura	Tank	10.00	x	1

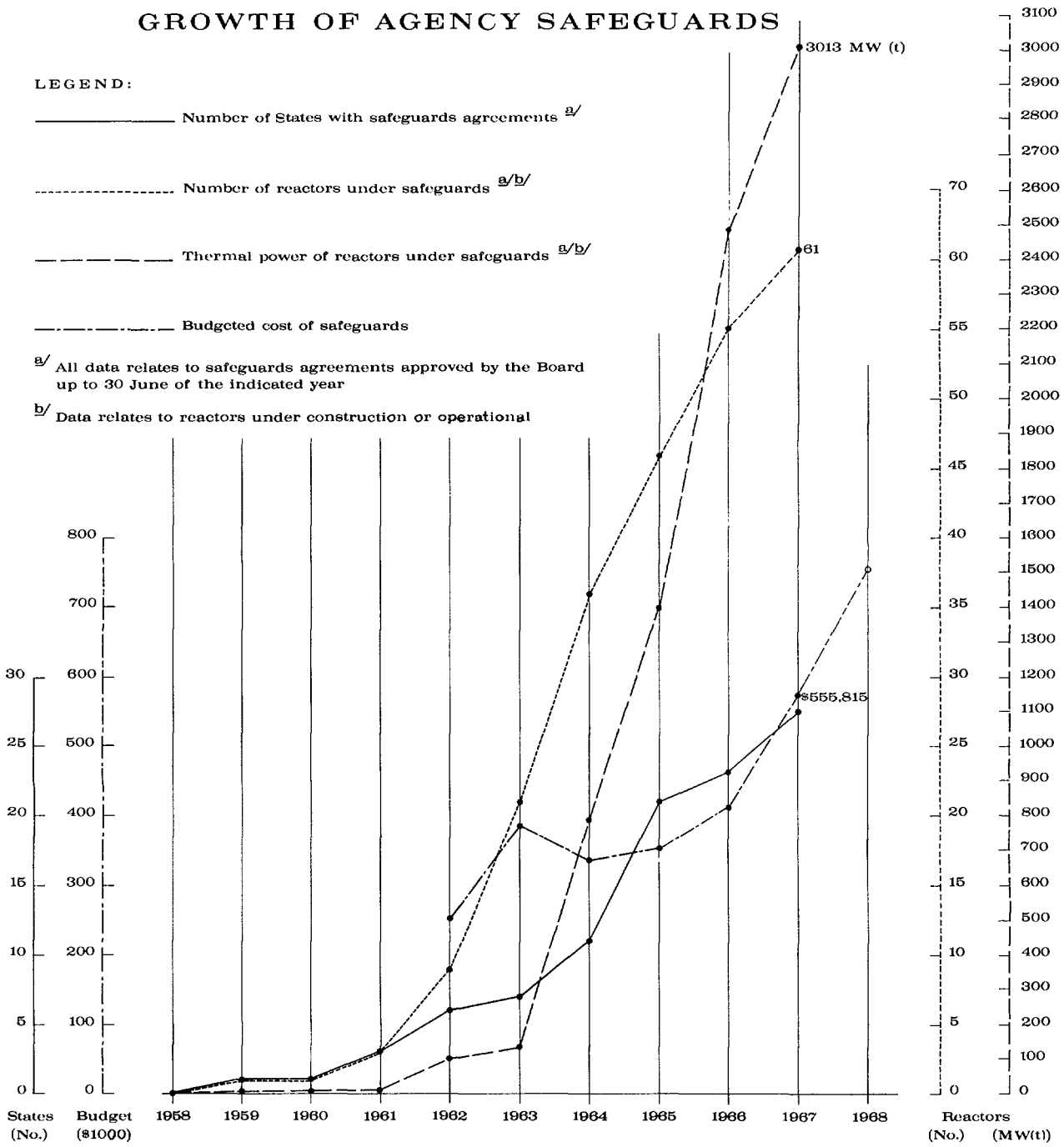
Member State	Name of reactor	Location	Type	Capacity MW(th)	In operation	Maximum routine inspections per year[c]
Japan (cont.)	JRR-4/Japan Research Reactor 4	Tokai-mura	Pool	1.00	x	1
	JPDR/Japan Power Demonstration Reactor	Tokai-mura	Boiling-Water	46.70	x	2
	SHCA/Semi-Homogeneous Critical Assembly	Tokai-mura	Crit. Fac.	.00	x	1
	AHCF/Aqueous Homogeneous Critical Facility	Tokai-mura	Crit. Fac.	.00	x	0
	TCA I/Tank-Type Critical Assembly	Tokai-mura	Crit. Fac.	.00	x	1
	TCA II/Tank-Type Critical Assembly	Tokai-mura	Crit. Fac.	.00	x	0
	Sumitomo Critical Assembly	Tokai-mura	Crit. Fac.	.00	x	0
	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
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	20.00	x	2

Member State	Name of reactor	Location	Type	Capacity MW(th)	In operation	Maximum routine inspections per year[c]
Spain	ARBI	Bilbao	Argonaut	.01	x	0
	ARGOS	Barcelona	Argonaut	.01	x	0
	CORAL I	Madrid	Zero energy fast reactor	.00		5
	JEN I	Madrid	Pool	3.00	x	1
	JEN II	Madrid	Pool	.00	x	
	ZORITA	Zorita de los Canes	Press. Water	510.00		A
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
	ZEBRA/Fast Critical Assembly	Winfrith	Crit. Fac.	.00	x	A
United States	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	TRIGA II/Yugoslavian Research Reactor	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/or name of reactor are given in brackets, the agreement is not yet in force.

c/ A = Access at all times.


GROWTH OF AGENCY SAFEGUARDS
LEGEND:
Number of States with safeguards agreements a/
Number of reactors under safeguards a/b/
Thermal power of reactors under safeguards a/b/
Budgeted cost of safeguards
a/ All data relates to safeguards agreements approved by the Board up to 30 June of the indicated year
b/ Data relates to reactors under construction or operational
3013 MW (t)
61
$555,815
States (No.)
Budget ($1000)
Reactors (No.)
(MW(t))
1958
1959
1960
1961
1962
1963
1964
1965
1966
1967
1968

ADMINISTRATION

(a) External relations

114. The Agency's Report to the General Assembly for 1965-66, presented by the Director General on 22 November 1966, served as a reference for the discussions of the possible role of Agency safeguards in the proposed Non-Proliferation Treaty, a subject that had already been discussed at some length under the relevant item of the General Assembly's agenda. There were a number of requests that the Agency should report more fully on its safeguards system to the General Assembly this year.

115. In November 1966 a series of comprehensive working arrangements was agreed to by the Secretariats of WHO and the Agency for co-operation in the main fields of mutual interest. The Joint FAO/IAEA Division of Atomic Energy in Food and Agriculture was placed on a permanent footing, the Directors General of both organizations having agreed that they would seek approval from their governing organs for an equal sharing in any expansion of the staff and work of the Division which was to be financed from the Regular Budgets of the two agencies. The Agency is co-operating with the International Bank for Reconstruction and Development on a study that the latter is making of the prospects for nuclear power in countries to which the Bank normally makes loans.

116. In accordance with the General Conference's Resolution GC(X)/RES/216 on the centenary commemoration of the birth of Marie Sklodowska-Curie, the Agency has extended various forms of help to the Government of Poland for a symposium which will commemorate this anniversary.

117. In October 1966 the Secretariat sent to OAU a revised draft relationship agreement to provide for co-operation between the Agency and the Educational, Scientific, Cultural and Health Commission of that organization [20], to which OAU subsequently suggested some changes. These were accepted by the Secretariat in January 1967, and it is understood that the text as thus modified will be submitted to the Council of Ministers of OAU in September.

118. In June 1967 the Board accepted the offer made by the Austrian Government to provide the Agency with a site and building for its permanent headquarters, recognizing the necessity for further detailed negotiations.

(b) Personnel

119. On 30 June 1967 the Secretariat had 300 staff members in the Professional category and above. 288 of these, of whom three were on secondment to other United Nations organizations, held permanent or fixed-term contracts, and 12 were serving under Special Service Agreements. 288 were serving at Headquarters, five at Trieste, four in Monaco, two at New York and one in Bangkok. The number of staff members holding posts that were subject to geographical distribution was 238; they came from 48 Member States. The Secretariat also had 462 General Service staff, ten of whom were serving in Monaco and ten at Trieste, and 190 in the Maintenance and Operatives Service. The total strength of the Agency's staff was thus 952 [21].

120. The organizational chart of the Agency's Secretariat shows the structure of the Secretariat as at 30 June 1967.

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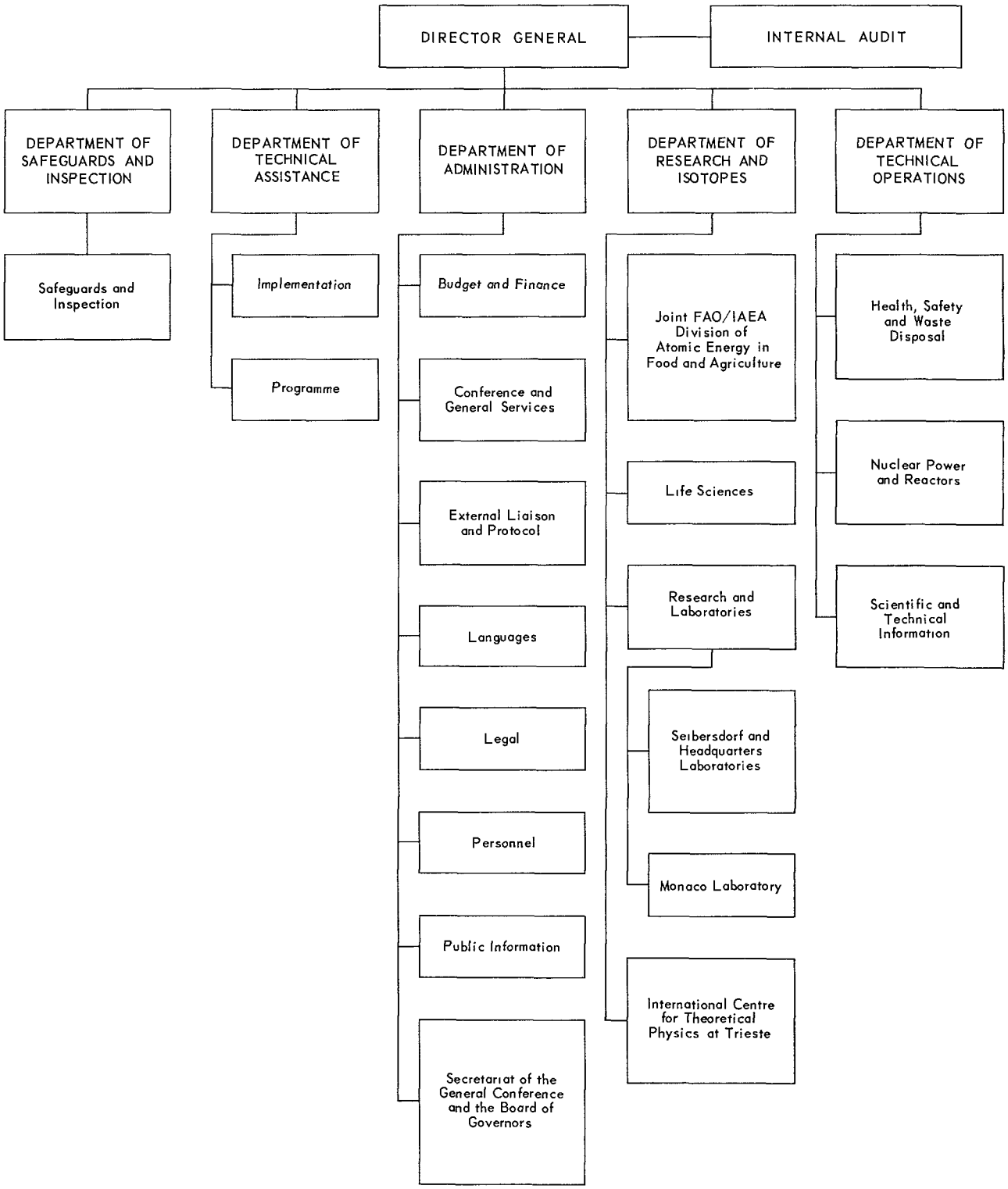
[20] GC(X)/330, para. 226.

[21] Details of the Agency's staff are to be found in document INFCIRC/22/Rev.7, 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 1966

121. The assessment of contributions for 1966 of Member States included in the scale of assessment for that year amounted to $8 426 500. The additional assessment of three new Member States (Jamaica, Jordan and Panama) increased the total by $10 955 to $8 437 455.

122. By 31 December 1966, the Agency had received contributions towards the Regular Budget for 1966 amounting to $7 683 571, which represents 91.07% of the total assessment. By 30 June 1967 $7 895 187 or 93.57% of the total contributions due had been received.

123. The Agency's obligations for 1966 amounted to $8 984 104. The original appropriation was only $8 744 000, of which $8 426 500 were to be financed from assessed contributions on Member States and $317 500 from miscellaneous income. The over-run of $240 104 in respect of increased costs of staff, therefore has to be covered by a supplementary appropriation, to be assessed on Member States, as authorized by the General Conference.[22]

124. Taking into consideration the additional appropriation of $240 104 which was provisionally withdrawn from the Working Capital Fund in order to cover the over-run of the total appropriation, there was, as of 31 December 1966, a provisional budgetary surplus of $70 974, as follows:

Contributions assessed on new Member States		$10 955
Excess of miscellaneous income over budget:		
Actual miscellaneous income	$377 519	
Less: Budget	317 500	60 019
Provisional budgetary surplus		$70 974

Since contributions in the amount of $753 884 were outstanding from Member States for 1966, there was a provisional cash deficit of $682 910.

125. Unliquidated obligations in respect of 1966 appropriations at 31 December 1966 were $789 255, of which $373 940 had been liquidated by 30 June 1967.

126. In 1966 transfers of funds between sections of the budget in the amount of $181 311 were made. Of this total, transfers in the amount of $173 450 resulted from the decision of the Board to meet the increase in the cost of salaries and other emoluments of staff [23] primarily by savings within the original appropriations, and to authorize the necessary transfers, as follows:

Section 6 - Distribution of information	$ 11 100
Section 7 - Scientific and technical services and laboratory charges	3 128
Section 8 - Salaries and wages	14 491
Section 9 - Common staff costs	144 731
	$173 450

[22] Resolution GC(X)/RES/209.

[23] See document GC(X)/328, para. 1.

The remaining balance of $7861 represents transfers in respect of other excess expenditure:

Section 6	- Distribution of information	$7 761
Section 11	- Representation and hospitality	100
		$7 861

which was met under the authorization given to the Director General by the Board to make transfers between appropriation sections on condition that not more than $5000 was transferred to any of them. The over-run on section 6 was more than offset by revenues in excess of the budget estimate for income from the sale of publications the printing of which caused the excess expenditure.

The financial year 1967

127. By 30 June 1967 the following advances to the Working Capital Fund and contributions to the Regular Budget for 1967 had been received:

Advances to the Working Capital Fund	$2 000 000
Contributions to the 1967 Regular Budget	$3 393 563

By that date Member States had thus paid 99.92% of the total advances due to the Working Capital Fund and 36.96% of the total contributions due to the 1967 Regular Budget, taking into consideration the assessments of the two new Member States (Sierra Leone and Singapore).

(ii) Operational Budget

128. Of a total amount of $1 276 655 pledged to the General Fund for 1966 by 31 December 1966, $689 393 had been paid by that date. By 30 June 1967 the total pledged was increased to $1 286 297 and receipts amounted to $1 167 573, leaving a balance of $118 724 still to be paid. With regard to the target of $2 million set for 1966 by the General Conference at its ninth regular session, there was a shortfall of approximately $714 000 in the actual pledges made by Member States.

129. The total operational obligations incurred during 1966 amounted to $2 327 167. Unliquidated obligations at 31 December 1966, including obligations brought forward from previous years, amounted to $722 379.

130. The total amount pledged to the General Fund for 1967 at 30 June 1967 was $1 362 922 of which $330 248 had been paid by that date.

(iii) The Agency's resources in 1966

131. Resources equivalent to more than $13 700 000 were at the Agency's disposal during 1966 under its own programmes, under UNDP/TA and Special Fund projects as well as other special projects, including contributions in cash, services and in kind. Details concerning these resources are set out in Table XIII below.

Table XIII

Funds and other resources at the disposal of the Agency in 1966[a/]

		$	$	$
Administrative Fund				
Assessed contributions to the regular budget				
Member States included in the scale for 1966		8 426 500		
New Members		10 955		
Supplemental appropriation for 1966		240 104	8 677 559	
Actual miscellaneous income			377 519	
	Sub-total			9 055 078
General Fund				
Voluntary contributions pledged for 1966				
At the end of the financial year		1 276 655		
Additional pledges and adjustments in 1967		9 642	1 286 297	
Miscellaneous income (from investments, laboratory, local project costs, exchange differences)			166 317	
Income from the Agency/United States Atomic Energy Commission Research Programme			11 705	
Special voluntary contributions pledged			322 898	
	Sub-total			1 787 217
Publications Revolving Fund				
Amount of expenditure including unliquidated obligations				87 770
Special Accounts				
Saudi Arabian Project Trust Fund				
Income from the Government of Saudi Arabia			14 000	
Joint Research Programme of the Agency and the United States Atomic Energy Commission				
Income from the Atomic Energy Commission			87 699	
Special fellowships offered by the Government of the Union of Soviet Socialist Republics[b/]			-	
United Nations Korean Reconstruction Agency Residual Fund[c/]				
Income from United Nations New York			-	
	Sub-total			101 699
United Nations Development Programme				
Technical Assistance Account[d/]				
Obligations incurred during the year 1966 (Project costs)				1 200 394
Special Fund[e/]				
Funds committed during the year 1966				710 071
Financial contributions received towards the cost of conferences, symposia and seminars for 1966				
Amounts pledged				16 984
Contributions in services and in kind[f/]				
Type II fellowships awarded[g/]			531 000	
Technical assistance equipment and supplies			77 500	
Laboratory equipment and supplies			115 950	
Library, etc.			3 314	
Special nuclear materials			49 639	
	Sub-total			777 403
	Total			13 736 616

a/ See the Agency's Accounts for 1966 (GC(XI)/361).

b/ Ibid., Statement VII. The total amount of Rb. 40 000 ($44 444) paid by the Soviet Union for fellowships extending over a number of years was shown in the accounts for 1962 (GC(VII)/231).

c/ Ibid., Statement VIII. The total contribution of $4000 is shown in the accounts for 1965 (GC(X)/331).

d/ Ibid., Statement IX.A.

e/ Ibid., Statement X.A.

f/ Ibid., Schedule G. In addition to monetary funds, contributions in services and kind were placed at the Agency's disposal. Not listed since not evaluable in dollars are the cost-free experts: 133 experts - 1006 man/days, in 1966.

g/ Ibid., Schedule G. The amount shown represents the total value of fellowships offered during the respective year, while many of the fellowships extend over a number of years.

(d) Legal matters

132. By 30 June 1967, 495 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, 82 were registered during the period 1 July 1966 to 30 June 1967, and 16 were registered with the United Nations pursuant to Article 102 of its Charter.

133. Argentina has deposited with the Agency an instrument of ratification of the Vienna Convention on Civil Liability for Nuclear Damage. Four Member States have now ratified this Convention (Argentina, Cuba, the Philippines and the United Arab Republic). [24]

134. The Agreement on the Privileges and Immunities of the Agency is now in force between the Agency and 25 of its Member States.

135. Upon further consideration of the question of emergency assistance in the event of nuclear radiation accidents [25], the Board decided at its meetings in February 1967 that for the time being no further work needs to be done to develop a multilateral agreement for such emergency assistance. The Board also requested the Director General to invite the attention of all Member States to the report of its Committee of the Whole, particularly to the draft of a model bilateral agreement between States for their use as they deem appropriate; and to continue, within the limits of available resources, to provide information, assistance and training in this important field as may be requested by Member States.

(e) Public information

136. The Agency's film "The Nuclear Challenge" was completed for a world premiere at the 1967 Universal Exposition in Montreal and subsequent showing at the United Nations pavilion of the Exposition; a television documentary, "A Decade of Atoms for Peace" will be distributed at the time of the eleventh regular session of the General Conference. A film, "The Watch on the Sea", showing the work of the Agency's International Laboratory of Marine Radioactivity was also made; it is being shown at the Monaco pavilion of the Universal Exposition.

137. The International Atomic Energy Bulletin was transformed from a quarterly into a bi-monthly publication as of the beginning of 1967.

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[24] Under Article XXIII of the Convention it will come into force three months after the deposit of the fifth instrument of ratification.

[25] See document GC(X)/335.

ANNEX I

THE BOARD OF GOVERNORS

To 28 September 1966	1966-1967	From 28 September 1966
	Argentina[a/b/]	
	Australia[c/b/]	
	Austria[d/]	
		Belgium[e/]
	Brazil[c/f/]	
	Canada[c/b/]	
Chile[a/]		
	Colombia[d/]	
Czechoslovak Socialist Republic[g/]		
		Denmark[e/]
	France[c/b/]	
		Germany, Federal Republic of[f/]
	Ghana[d/]	
	India[c/b/]	
		Indonesia[f/]
	Japan[c/b/]	
	Korea, Republic of[d/]	
		Lebanon[f/]
		Mexico[f/]
Netherlands[a/]		
	Pakistan[d/]	
		Poland[e/]
Portugal[g/]		
	South Africa[c/b/]	
Sweden[g/]		
Thailand[g/]		
	Tunisia[d/]	
	Union of Soviet Socialist Republics[c/b/]	
United Arab Republic[a/]		

To 28 September 1966	1966-1967	From 28 September 1966
	United Kingdom of Great Britain and Northern Ireland[c/b/]	
	United States of America[c/b/]	
	Yugoslavia[d/]	

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

b/ Designated by the Board on 15 June 1966 under Article VI. A. 1 of the Statute.

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

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

e/ Designated by the Board on 15 June 1966 under Article VI. A. 2 of the Statute.

f/ Elected by the General Conference on 27 September 1966 under Article VI. A. 3 of the Statute.

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

ANNEX II

FELLOWSHIPS OFFERED OR PROVIDED FREE OF CHARGE BY MEMBER STATES IN 1966

Member State	Number of fellowships Offered	Utilized[a]
A. Country programme		
Argentina	5	2
Austria	3	3
Belgium	6	5
Brazil	3	1
China	2	-
Czechoslovak Socialist Republic	9	1
Denmark	5	2
Germany, Federal Republic of	4	2
Hungary	4	-
India	5	7
Israel	9[b]	1
Italy	20[c]	18
Japan	10	15
Mexico	1	1
Netherlands	8[c]	7
Pakistan	5	-
Poland	5[d]	1
Romania	15	2
Spain	5	3
Sweden	4	2
Switzerland	2	1
Tunisia	2	-
Union of Soviet Socialist Republics	-	2[e]
United States of America	40[f]	57
Yugoslavia	3	2
Sub-total	175	135
B. International programme		
Joint Institute for Nuclear Research (JINR), at Dubna, Soviet Union	3	2
Total	178	137

a/ Number of awards less withdrawals and rejections.
b/ 90 man/months.
c/ Offer communicated verbally to the Secretariat.
d/ 60 man/months.
e/ These include one long-term award.
f/ Number based on estimated cost per fellow.

ANNEX III

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. Within the framework of these offers, and in response to a request by Mexico, equipment for a radiodiagnostic laboratory was donated by Poland and Bulgaria jointly.

3. At the ninth regular session of the General Conference, the Government of France made an offer of a low-temperature (liquid nitrogen) irradiation loop [2]; this equipment has now been donated to Israel.

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 laboratories

Donor country	Equipment
Germany, Federal Republic of	Micro analysis unit
Israel	Radiation analyser (Mössbauer effect spectrometer) and accessories
Italy	Laboratory scale
Sweden	3 calculating machines, 3 centrifuges, 2 column electrophoresis units, 3 fraction collectors, 8 intensimeters, a microscope with accessories, 3 paper electrophoresis units, 8 peristaltic pumps, a Porath electrophoresis column, several other laboratory accessories, and a Volvo sedan
United States	A gas proportional counter and an anti-coincidence counting unit

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

[2] See GC(IX)/OR.93, para. 39.

5. In 1966 the United States donated equipment grants in kind for the projects within the Agency's approved programme, as listed below.

Recipient country	Equipment
Brazil	Humidifier, dryomatic dehumidifier, dry bulb temperature recorder and Cutie Pie survey meter with chambers
Chile	Shielded flow counter, flow counter with preamplifier, scaler, lead bricks, lead storage container and other accessories
Colombia	A double-beam spectrophotometer with accessories
El Salvador	Cliniscaler, well detector, magnaprobe, straight bore collimator, distance bar, voltage stabilizer and other accessories
Mexico	Preamplifiers, amplifiers, coincidence units, delay amplifier, detector control unit and other accessories
Peru	Low background system, survey meter, air sampler, monitor and detector stand
Philippines	Picker Magnascanner III and rectilinear recorder
Sudan	Ionization meter and low beta counting system
Thailand	128-channel analyser with accessories
Tunisia	A complete low background counting system
Viet-Nam	Dual scanner with scintillation detector, analyser computer, analytical ratemeter with printer and photo records

ANNEX IV

NUCLEAR POWER STATIONS IN MEMBER STATES[a/]

I. Experimental power reactors (output below 20 MW(e))

A. In operation

Name	Location	Type	Net output (MW(e))	Criticality date
Belgium				
BR-3	Mol	PWR	10.5	Aug 1962[b/]
France				
G-1	Marcoule	GCR	2	Jan 1956
Germany, Federal Republic of				
KAHL (VAK)	Grosswelzheim/Kahl (Main)	BWR	15	Nov 1960
AVR	Jülich	HTGR	15	Aug 1966
Japan				
JPDR	Tokai-mura	BWR	11.25	Aug 1963
Sweden				
AGESTA	Agesta	PHWR	9	Jul 1963
United Kingdom				
DFR	Dounreay	FBR	14	Nov 1959
United States of America				
EBWR	Lemont	BWR	4	Dec 1956
SAXTON	Saxton	PWR	3	Apr 1962
CVTR	Parr	PHWR	17	Mar 1963
PNPF	Piqua	OMR	11.4	Jun 1963
EBR-2	Idaho Falls	FBR	16.5	Nov 1963
BONUS	Punta Higuera	BWR + nuclear superheat	16.5	Apr 1964
Union of Soviet Socialist Republics				
APS	Obninsk	LWGR	5	May 1954
TES-3	Obninsk	PWR	1.5	1961
ARBUS	Melckess	OMR	0.50	Jun 1963

Name	Location	Type	Net output (MW(e))	Criticality date
		B. Under construction		
Switzerland				
LUCENS	Lucens	HWGCR	7.5	Dec 1966
Union of Soviet Socialist Republics				
BILIBIN (CHUKOTA)	Bilibin, Chukota region (Siberia)	-	4 x 12	1970
		II. Medium power reactors (output between 20 MW(e) and 100 MW(e))		
		A. In operation		
Canada				
NPD	Rolphton	PHWR	22.5	Apr 1962
France				
G-2 (G-3)	Marcoule	GCR	2 x 36	Jul 1958/ Jun 1959
CHINON-1 (EDF-1)	Chinon	GCR	60	Sep 1962
EL-4	Brennilis	HWGCR	70	Dec 1966
Germany, Federal Republic of				
MZFR	Karlsruhe	PHWR	56	Sep 1964
United Kingdom				
CALDER HALL	Calder Hall	GCR	3 x 51) 1 x 45)	May 1956/ Mar 1959
CHAPELCROSS	Chapelcross	GCR	3 x 47) 1 x 50)	Nov 1958/ Dec 1959
AGR	Windscale	AGR	34	Aug 1962
United States of America				
SHIPPINGPORT	Shippingport	PWR	90	Dec 1957
BIG ROCK POINT	Charlevoix	BWR	70.4	Sep 1962
ERR	Elk River	BWR	22	Nov 1962
HUMBOLDT BAY	Humboldt Bay	BWR	68.5	Feb 1963
ENRICO FERMI	Lagoona Beach	FBR	60.9	Aug 1963
PATHFINDER	Sioux Falls	BWR + nuclear superheat	58.5	Mar 1964
PEACH BOTTOM (HTGR-1)	Peach Bottom	HTGR	40	Mar 1966

Name	Location	Type	Net output (MW(e))	Criticality date
Union of Soviet Socialist Republics				
URAL 1	Beloyarsk	BWR + nuclear superheat	94	Sep 1963
VK-50 (Ulyanovsk)	Melckess	BWR	70	Apr 1965
	B. Under construction			
Germany, Federal Republic of				
HDR	Grosswelzheim/Kahl (Main)	BWR nuclear superheat	25	1968
KNK	Karlsruhe	SZR	20	1968
Netherlands				
DODEWAARD	Dodewaard	BWR	47	1968
United Kingdom				
SGHWR	Winfrith	SGHWR	93	1967
United States of America				
LACBWR	Genoa	BWR	50	1967
	III. Large power reactors (output above 100 MW(e))			
	A. In operation			
Canada				
CANDU-PHW-200	Douglas Point	PHWR	203	Nov 1966
France				
CHINON-2 (EDF-2)	Chinon	GCR	200	Aug 1964
CHINON-3 (EDF-3)	Chinon	GCR	475	Mar 1966
CHOOZ (SENA)[c/]	Chooz	PWR	266	Oct 1966
Germany, Federal Republic of				
KRB	Gundremmingen	BWR	237	Aug 1966
Italy				
LATINA (SIMEA)	Latina (Foce Verde)	GCR	200	Dec 1962
GARIGLIANO (SENN)	Garigliano (Sossa Aurunca)	BWR	150	Jun 1963
ENRICO FERMI (SELNI)	Trino Vercellese	PWR	247	Jun 1964
Japan				
JAPCO	Tokai-mura	GCR	158.5	May 1965

Name	Location	Type	Net output (MW(e))	Criticality date
United Kingdom				
BERKELEY	Berkeley	GCR	2 x 138	Aug 1961/ Mar 1962
BRADWELL	Bradwell	GCR	2 x 150	Aug 1961/ Apr 1962
HUNTERSTON - A	Hunterston	GCR	2 x 161	Sep 1963/ Mar 1964
HINKLEY POINT - A	Hinkley Point	GCR	2 x 150	May 1964/ Oct 1964
TRAWSFYNYDD	Trawsfynydd	GCR	2 x 250	Sep 1964/ Dec 1964
SIZEWELL	Sizewell	GCR	2 x 290	Jun 1965/ Dec 1965
DUNGENESS A	Dungeness	GCR	2 x 275	Jun 1965/ Sep 1965
United States of America				
DRESDEN - 1	Morris	BWR	200	Oct 1959
YANKEE	Rowe	PWR	175	Aug 1960
INDIAN POINT - 1	Indian Point[d/]	PWR	270	Aug 1962
NPR	Richland	LWGR	786	Dec 1966
Union of Soviet Socialist Republics				
SIBERIAN	Troitsk	LWGR	(6 x 100)	Sep 1958/ Dec 1962
WWER - 1	Novo Voronezh	PWR	196	Dec 1963
B. Under construction				
Canada				
CANDU-PHW-500 (1st and 2nd reactors)	Pickering Township near Toronto	PHWR	4 x 505	1970/1971
Czechoslovak Socialist Republic				
HWGCR	Behunice	HWGCR	150	1968
France				
SAINT LAURENT DES EAUX - 1 (EDF-4)	Saint Laurent des Eaux	GCR	487	1968
SAINT LAURENT DES EAUX - 2	Saint Laurent des Eaux	GCR	487	1969/1970
BUGEY - 1 (EDF-5)	Bugey near Lyon	GCR	487	1970/1971

Name	Location	Type	Net output (MW(e))	Criticality date
Germany, Federal Republic of				
KWL	Lingen	BWR fossil fuel superheat	240[e/]	1968
KWO	Obrigheim	PWR	282.7	1968
KKN	Niederaichbach	HWGCR	100	1968/1969
India				
TARAPUR	Tarapur	BWR	2 x 190	1968
RAJASTHAN-1	Rana Pratap Sagar	PHWR	2 x 200	1969
Japan				
TSURUGA	Tsuruga	BWR	307	1969
KANSAI ELECTRIC POWER CO. (MIHAMA-1)	Niu. Tsuruga Peninsula	PWR	340	1970
FUKUSHIMA	Okuma - Cho	BWR	380	1970
Pakistan				
KANUPP	Paradise Point near Karachi	PHWR	125	1971
Spain				
ZORITA - 1	Zorita de los Canes	PWR	153.2	1968
SANTA MARIA LA GARONA	Santa Maria la Garona	BWR	440	1969
Sweden				
MARVIKEN (R-4/EVA)	Marviken	BHWR	140[f/]	1968
OKG	Oskarshamn	BWR	400	1970
Switzerland				
NOK	Beznau near Doettingen	PWR	350	1969
BKW	Mühleberg	BWR	306	1971
United Kingdom				
OLDBURY	Oldbury	GCR	2 x 300	1967
WYLFA	Wylfa	GCR	2 x 590	1968/1969
DUNGENESS B	Dungeness	AGR	2 x 600	1969/1970
PFR	Dounreay	FBR	250	1970

Name	Location	Type	Net output (MW(e))	Criticality date
United States of America				
SAN ONOFRE	San Clemento	PWR	430	1967
CONNECTICUT YANKEE	Haddam Neck	PWR	462	1967
OYSTER CREEK	Oyster Creek	BWR	515	1968
NINE MILE POINT	Oswego, N.Y.	BWR	500	1967
INDIAN POINT - II	Indian Point	PWR	873	1969
DRESDEN - 2	Morris	BWR	715	1969
MILLSTONE POINT	Waterford, Conn.	BWR	549.2	1969
CONSUMERS POWER CO.	Palisades Park (Mich.)	PWR	710	1970
DRESDEN-3	Morris	BWR	715	1970
R.E. GINNA - 1	New York	PWR	420	1969
TURKEY POINT - 3	Florida	PWR	721.5	1971
TURKEY POINT - 4	Florida	PWR	721.5	1972
H.B. ROBINSON	South Carolina	PWR	663	1970
QUAD-CITIES - 1	Illinois	BWR	715	1970
QUAD-CITIES - 2	Illinois	BWR	715	1971
BROWN'S FERRY-1	Alabama	BWR	1 064.5	1970
BROWN'S FERRY-2	Alabama	BWR	1 064.5	1971
Union of Soviet Socialist Republics				
URAL - II	Beloyarsk	BWR + nuclear superheat	200	1967
WWER - II	Novo-Voronezh	PWR	365	1967
BN - 350	Shevchenko (Caspian Sea)	FBR	150[g/]	-

a/ Explanation of abbreviations:

AGR Advanced gas-cooled, graphite-moderated reactor
BHWR Boiling heavy-water-moderated and cooled reactor
BWR Boiling light-water-moderated and cooled reactor
FBR Fast breeder reactor
GCR Gas-cooled, graphite-moderated reactor
HTGR High-temperature gas-cooled, graphite-moderated reactor
HWGCR Heavy-water-moderated, gas-cooled reactor
HWLWR Heavy-water-moderated, light-water-cooled reactor
HWOR Heavy-water-moderated, organic-cooled reactor
LWGR Light-water-cooled, graphite-moderated reactor
OMR Organic-moderated and cooled reactor
PHWR Pressurized heavy-water-moderated and cooled reactor
PWR Pressurized light-water-moderated and cooled reactor
SGHWR Steam-generating heavy-water reactor
SGR Sodium-cooled, graphite-moderated reactor
SZR Sodium-cooled, zirconium hydride-moderated reactor

b/ Presently shut down to test VULCAIN core.

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

d/ A reactor equipped with oil-fired superheater.

e/ Power output includes 90 MW(e) from conventional superheat.

f/ To be raised to 200 MW with nuclear superheat.

g/ Initially rated at 350 MW(e). Electrical power output has been decreased to 150 MW(e) to allow desalted water production (120×10^6 litres/day).

ANNEX V

RESEARCH CONTRACTS

A. Total value of contracts in 1966

Year	New contracts	Renewals	Total	Value
1966	69	109	178	846 065

B. Analysis by subject matter of contracts awarded or renewed in 1966

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	13	3	122 252	-	122 252
Health physics and radiation protection	-	11	58 035	-	58 035
Radiation biology	9	13	76 340	-	76 340
Studies involving reactors	9	6	129 380	-	129 380
Applications of radioisotopes in agriculture	15	42	106 885	67 025	173 910
Food irradiation	5	3	33 900	-	33 900
Applications of radioisotopes in hydrology	4	8	50 560	-	50 560
Applications of radioisotopes in industry	4	-	20 493	-	20 493
Applications of radioisotopes in medicine	10	23	112 255	68 940	181 195
Total	69	109	710 100	135 965	846 065

Country	Number of contracts placed	Number of contracts renewed	Contribution from Regular Budget	Contribution from Operational Budget	Total
Turkey	5	-	21 600	7 150	28 750
Union of Soviet Socialist Republics	1	2	47 990	-	47 990
United Arab Republic	6	4	21 550	24 400	45 950
United Kingdom	2	1	23 500	-	23 500
Uruguay	-	1	-	7 000	7 000
Yugoslavia	1	2	16 217	-	16 217
Total	69	109	710 100	135 965	846 065