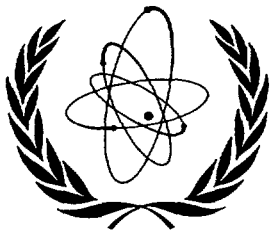

International Atomic Energy Agency

ANNUAL REPORT OF THE BOARD OF GOVERNORS TO THE GENERAL CONFERENCE

1 July 1963 - 30 June 1964

GC(VIII)/270

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CONTENTS

LIST OF ABBREVIATIONS

CERN	European Organization for Nuclear Research
CTCA	Commission for Technical Co-operation in Africa
ECAFE	United Nations Economic Commission for Asia and the Far East
ECOSOC	Economic and Social Council of the United Nations
EPTA	United Nations Expanded Programme of Technical Assistance
ENEA	European Nuclear Energy Agency of the Organisation for Economic Co-operation and Development
FAO	Food and Agriculture Organization of the United Nations
IANEC	Inter-American Nuclear Energy Commission of the Organization of American States
ICRP	International Commission on Radiological Protection
ICRU	International Commission on Radiological Units and Measurements
ILO	International Labour Organisation or International Labour Office
TAB	Technical Assistance Board (of the United Nations)
UNESCO	United Nations Educational, Scientific and Cultural Organization
WHO	World Health Organization
WMO	World Meteorological Organization

NOTE

Unless otherwise indicated all sums of money are expressed in United States dollars.

INTRODUCTION

1. The Board [1] presents the following report on the Agency's work during its seventh year.

2. During the period under review - from 1 July 1963 to 30 June 1964 - the membership of the Agency increased from 82 to 87. The five new Members are: Algeria, Gabon, Ivory Coast, Libya and Nigeria.

3. This period has been marked by further notable improvement in the prospects for economically competitive nuclear power and by interesting developments with regard to the use of nuclear energy for desalting. These are beginning to have an influence on the Agency's programme that may become more evident after the Third International Conference on the Peaceful Uses of Atomic Energy which is to be held in Geneva from 31 August to 9 September 1964.

4. On 26 February 1964 the Board decided to extend the Agency's safeguards system to reactors of more than 100 thermal megawatts and to set up a Working Group of the whole to review the safeguards system. The Working Group held a short organizational meeting on 28 February, and began its work on 20 May when it met until 27 May.

5. Pursuant to Resolution GC(VII)/RES/160, whereby the General Conference requested the Director General to give the fullest co-operation to the Secretary-General of the United Nations in the fulfilment of the task entrusted to him by Resolution 982 (XXXVI) of the Economic and Social Council, and to a request by the Secretary-General, the Agency has submitted a further study on the economic and social consequences of disarmament for the development of the peaceful uses of nuclear energy. [2]

6. In accordance with the request of the General Conference [3] the Board has considered the question of financing the Agency's activities but has not found it possible to make any further recommendations.

7. The Agency's technical assistance programme in 1963 was reviewed by the Board, and a report thereon is being submitted separately to the General Conference. [4] Attention is also drawn to the first report on the Agency's laboratory activities [5] which gives a description of the work being undertaken at Headquarters, Seibersdorf and Monaco, as well as the Middle Eastern Regional Radioisotope Centre for the Arab Countries in Cairo.

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

[2] GC(VIII)/INF/71.

[3] Resolution GC(VII)/RES/143.

[4] GC(VIII)/INF/72.

[5] Technical Reports Series No. 25, IAEA Laboratory Activities.

CHAPTER I. RESEARCH AND SERVICES IN THE LIFE SCIENCES

8. The Agency has continued to promote co-ordinated research programmes of a specifically international character and to assist its Members, and especially the developing countries, to acquire techniques of research which have already been evolved in the highly developed countries. The various applications of radioisotopes and radiation sources in medicine, agriculture and biology therefore continue to be an important part of the Agency's research and assistance activities.

1. Medicine

9. The medical uses of isotopes and radiation sources continue to increase throughout the world. Further advances have been made as a result of the introduction of more sophisticated techniques and equipment and the appearance on the market of new radioisotopes and labelled compounds. The number of hospital radioisotope laboratories has also continued to grow, particularly in the less-developed countries, and nuclear medicine is beginning to be recognized as a medical specialty of its own. Workers in this field are organizing themselves in national societies of nuclear medicine; the founding of international societies of medical physics and biophysics illustrates the growing importance of the contribution that physics can make to the development of medical research, diagnosis and therapy.

10. The work of the Agency is designed to assist Member States and individual institutions in the development of the physical and technical aspects of nuclear medicine. Most of this work has been done in collaboration with WHO. Expenditure incurred in support of this work is shown in the table below:

Year	Amount in US dollars
1959	22 920
1960	40 635
1961	86 570
1962	109 163
1963	142 525

Diagnostic and research applications

11. The Agency's research programme in medical applications of radioisotopes has continued to grow.

12. Clinical research using human beings as experimental subjects is more difficult to plan in advance and to co-ordinate than research with animals or plants. Nevertheless the contracts awarded by the Agency deal increasingly with such research, and in particular certain topics to which priority was assigned in 1962 by a meeting of experts in which WHO participated. [6] These topics are: (a) anaemia, (b) goitre, (c) parasitology and (d) malnutrition. They are primarily of importance to developing countries and affect large numbers of people; most of the contracts were awarded to institutions in these countries. At present some 30 projects are under way in Australia, Austria, Belgium, Ceylon, Chile, Colombia, Congo (Leopoldville), India, Israel, Jamaica (under a grant to an institution in the United Kingdom of Great Britain and Northern Ireland), Kenya, the Republic of Korea, Lebanon, Mexico, the Philippines, Portugal, Romania, South Africa, Sweden, Switzerland, Thailand, Turkey, the United Arab Republic and Venezuela. A number of research projects have been completed. [7]

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[6] See document GC(VII)/228, para. 60.

[7] Technical Reports Series No. 28, IAEA Research Contracts, Fourth Annual Report.

13. Certain aspects of this programme were considered by two panels of experts: at one meeting in December 1963 a panel discussed the use of isotopes in the study of red cell life span in anaemia; the other, which met in June 1964, considered their application to the study of protein metabolism, with particular reference to malnutrition. The Agency's research programme on the medical uses of Ca^{47} was completed. A final meeting of the contractors was held in September 1963 to review and summarize the results achieved; the report of this group is to be published [8] and will be of use to physicians using Ca^{47} for diagnostic and research work on calcium and strontium metabolism and bone cancer.

14. New techniques for determining the distribution of radioisotopes in the body and its organs were discussed at the second Symposium on Medical Radioisotopes Scanning, organized in Athens in April 1964, with the scientific co-operation of WHO. Significant advances were reported in both the equipment and the radioactive materials used in these techniques. These developments are of importance to the Agency's research contract and laboratory programme. One laboratory project deals with the development of quantitative procedures to evaluate the pictorial information provided by scanning machines and thereby improve the diagnostic significance of results obtained in individual patients. Plans are being made to develop an international programme for the comparison of scanning equipment once the Agency's project for the international calibration of thyroid radioiodine uptake measurements has been completed by mid-1965. This project is continuing as planned, the Agency's expert having visited, during the period under consideration, about one hundred hospital isotope laboratories in Argentina, Brazil, Bulgaria, Chile, Colombia, the Czechoslovak Socialist Republic, Ecuador, El Salvador, Guatemala, Hungary, Mexico, the Netherlands, Paraguay, Peru, Poland, Sweden, the United States of America and Venezuela. A standard thyroid uptake collimator was designed and constructed in the Agency's Laboratory and blueprints of it were provided upon request. [9]

15. Thirty fellowships were awarded during 1963 to enable physicians and physicists from developing countries to study the medical applications of radioisotopes in advanced countries. In addition, a Regional Training Course on the Applications of Radioisotopes in Medicine was held in Buenos Aires from 12 August to 2 December 1963 for students from Latin American countries. During the period under review, two experts in medical uses of radioisotopes have completed their technical assistance assignments in Argentina and Brazil, and four are at present working in Afghanistan, Chile, the Republic of Korea and Viet-Nam; ten further technical assistance projects on these subjects were approved for Bolivia, Brazil, Burma, India, Ghana, Greece, Morocco, Nigeria, Senegal and Tunisia. Information on recent progress in nuclear medicine is regularly provided to some 900 hospital isotope laboratories in the form of a list of references.

Toxicology of radionuclides in man

16. One important aspect of the medical applications of radioisotopes is the possible hazard associated with their use. A number of institutes in the Czechoslovak Socialist Republic, Poland and Switzerland are conducting studies under Agency research contracts on luminous dial painters carrying body burdens of radium and strontium-90. The Laboratory is assisting this programme by training physicists from these institutions, by providing calibrated samples and by holding regular meetings for the exchange of information and for planning further work. At the Symposium on the Assessment of Radioactive Body Burdens in Man, jointly organized by the Agency, ILO and WHO in Heidelberg, Federal Republic of Germany, in May 1964, it was stressed that data on the toxicology of radionuclides available from the few cases of contamination are still scarce and that further research is urgently needed.

17. Included in the above-mentioned programme is a study of patients in the Vienna area who are carrying body burdens of Thorotrast, using the whole-body counter facility set up in the Laboratory with the assistance of the United States Atomic Energy Commission. In

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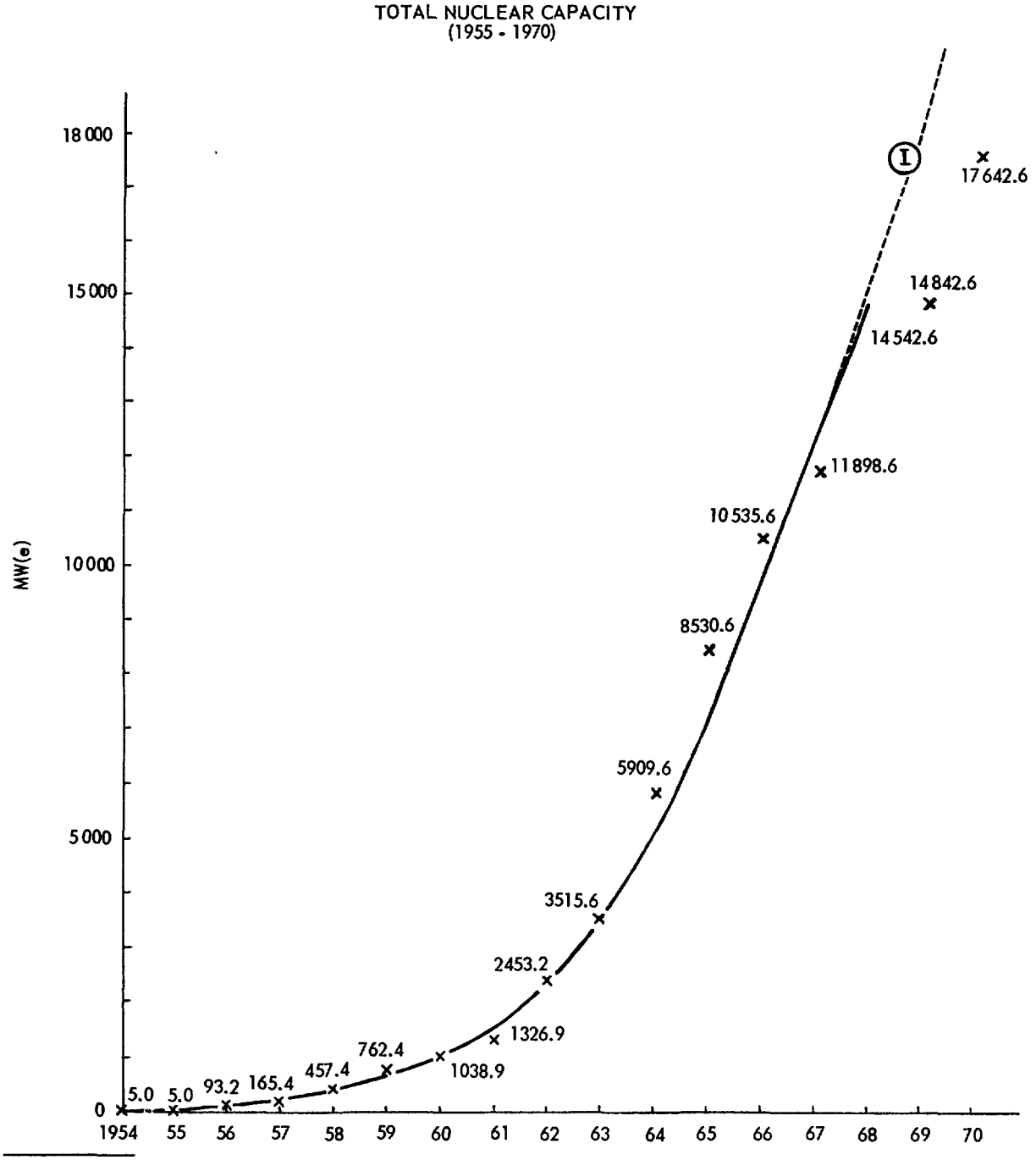
[8] Technical Reports Series, Medical Uses of Calcium-47 (in print).

[9] Belcher, E.H., Gómez-Crespo, G., Trott, N.G. and Vetter, H.: A standard collimator for thyroid radioiodine uptake measurements, Nuclear-Medizin 4, (1964).

this type of study, stability of the gamma spectrometry system is very important and a new method of stabilization has been developed and is now copied by several other whole-body counting laboratories. [10] A list of 1350 references to papers on the diagnostic use and biological effects of Thorotrast was completed. To a small extent, the whole-body counter is also used to develop diagnostic applications of such instruments.

Physics of radiotherapy

18. The number of radiation sources used for radiotherapy has continued to increase (see chart below). A technical directory recently compiled by the Agency lists more than 1600 radiocobalt units and other high-energy equipment in operation in 56 countries. The Agency has consequently increased its efforts to assist Member States and individual hospitals in improving the physics of radiotherapy. Besides providing a small number of fellowships on this subject, it has organized with the help of the British Hospital Physicists' Association an Advanced International Training Course on the Physics of Radiotherapy from 2 September 1963 to 31 January 1964 in London and other cities of the United Kingdom.



[10] Dudley, R. A. and Scarpatetti, R.: Stabilization of a gamma scintillation spectrometer against zero and gain drifts, Instr. & Meth. 25, 297 (1964).

19. An inter-regional adviser on the physical aspects of radiotherapy [11] stationed in Beirut, Lebanon, gives help to radiotherapy centres in Cyprus, Greece, Iran, Iraq, Lebanon, Sudan, Syria, Turkey and the United Arab Republic. Technical assistance experts on hospital physics are working in Ceylon, Lebanon and Thailand.

20. In February 1964 the Board took note of the offer by the Czechoslovak Socialist Republic to supply the Government of Algeria with the equipment for a medical centre consisting of a complete therapeutic irradiation unit and an oncological unit. The radiocobalt unit made available by the Czechoslovak Socialist Republic to the Agency for the United Arab Republic, and accepted by the Board in September 1962, is expected to be in operation this summer at the University Hospital in Alexandria.

21. The Agency has continued to compile physical data essential for accurate radiotherapy with high-energy equipment. Following the publication of a collection of dosimetric data for medium-energy X-ray therapy [12] a large number of data for high-energy radiation have been collected as the basis for three atlases covering single-field, multiple-field and moving-field therapy respectively; these atlases are at present in print. A service on Radiation Data for Medical Use has been set up which provides medical institutions with diagrams and data relating to radiotherapy physics on request and at nominal cost. An experts' meeting was held in May 1964 to review the data collected and to make recommendations on the possible future expansion of this service.

22. Radioisotopes such as Au^{198}, Co^{60}, Cs^{137} and Ta^{184} are being increasingly used for interstitial, intracavitary and surface radiotherapy, and a group of experts convened in November 1963 prepared a set of recommendations on the physical aspects of these techniques and for possible standardization of types and dimensions of sources.

2. Agriculture

23. In most areas of the world the application of isotopes in agriculture is still much less extensive than in medicine. The Agency's work in this connection is concentrating for the time being on problems such as the relationship between plant and soil, pest control, plant breeding, disease control and irradiation of marine products as well as agricultural food products.

(a) Agriculture

Soil-plant relations

24. World expenditures for fertilizers run annually into several millions of dollars and a more efficient use of them would have a marked effect on national economies particularly in developing countries. In 1962 the Agency started a Co-ordinated Research Programme on the Application of Isotopes and Radiation in Rice Cultivation to promote the better use of fertilizers in the rice-growing areas of the world. [13] Following the recommendations of a panel of experts in August 1963, the Agency also began a similar Co-ordinated Research Programme for the Use of Isotopes and Radiation in Maize Cultivation, particularly in regions of Latin America.

25. The studies conducted under the rice programme have shown that the simplest methods of phosphorus fertilizer application, namely broadcasting the fertilizer on the surface or broadcasting it on the surface and hoeing it in, are the best. It has also been found that there is considerable latitude as to the time at which phosphorus fertilizer can be applied for it still to be effective; because of the problems of fertilizer supply and

[11] See document GC(VII)/228, para. 64.

[12] Tsien, K.C. and Cohen, M.: Isodose charts and depth dose tables for medium energy X-rays, Butterworths, London (1962).

[13] Initially the programme involved the participation of institutes in Burma, Hungary, Pakistan, the Philippines, Thailand and the United Arab Republic (see document GC(VI)/195, para. 62). It was later extended to include additional institutes in Pakistan and the Republic of Korea (see document GC(VII)/228, para. 66).

distribution in developing countries, the rice farmer may not get the fertilizer until after the rice is planted in the paddy, but broadcasting the fertilizer over the growing rice was shown to be almost as effective as earlier application.

26. At a planning meeting of research workers participating in the rice programme which was held in Tokyo in January 1964, plant samples supplied by all the contractors were analysed for radioactive and total phosphorus content.

27. The maize programme mentioned above has begun in Brazil, Mexico, Peru and Romania. Yields of maize are very low in Latin America [14], and a main cause is the lack of proper and adequate fertilization. Since nitrogen deficiency is the principal limiting factor, the main emphasis in the field research centres participating during the first year of the programme is placed on questions concerned with nitrogen fertilization using nitrogen-15 for fertilizer labelling.

28. In September 1963, FAO and the Agency, in co-operation with the International Soil Science Society, held a technical meeting at Brunswick, Federal Republic of Germany, to discuss recent findings and discoveries in the use of radioisotopes as a technique for tracing organic matter in soils.

29. A Regional Training Course on the Application of Radioactive Isotopes in Soil-Plant Relations was held in Ankara, Turkey, from 30 September to 25 November 1963, and was attended by 19 students from seven countries.

Pest control

30. The use of radioisotopes and radiation to control and particularly to eliminate certain insect pests by the induced male sterility technique is increasing. This technique utilizes the mating instinct to bring about the eradication of a species without harming any other species in the environment (eradication by chemical means is generally undesirable because of insecticide residues and the destruction of useful species of insects and other animals). By the induced male sterility technique, the Oriental fruit fly has been eradicated from islands in the Bonin and Caroline Archipelagoes, and it is believed that the screw-worm has been eradicated from the southwestern United States thus completing the eradication of the insect from that country.

31. On the recommendation of a panel held in Vienna in October 1962 on Insect Population Control by the Sterile Male Technique [15], the Agency is undertaking a co-ordinated programme on control of insects by the use of radiation. Institutes in Australia, Belgium, El Salvador, Israel, Italy, Rhodesia and Tunisia are participating in the programme which adapts and uses, whenever possible, the research information obtained from other investigations such as those undertaken to eliminate the Oriental fruit fly and the screw-worm. Under this programme one laboratory works on the determination of radiation doses necessary to cause permanent sterility in certain fruit flies, another does research on mass rearing and another studies the population dynamics, dispersal and mating competitiveness of sterile fruit flies in the field.

32. In tsetse fly research one laboratory is studying the microclimatic requirements for the fly to develop, breed and reproduce, while another is investigating mass rearing and ecology.

33. Research on olive fly eradication has progressed far enough to make it possible to prepare for a small-scale experiment on population dynamics, ecology and eradication in the last quarter of 1964. Studies of this type should yield sufficient scientific and technical information to permit the eradication of the olive fly and the Mediterranean fruit fly in their entire range at a cost that is economically acceptable (for the Mediterranean fruit fly the cost is estimated to be one fourth to one third of the cost of eradication by chemical means).

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[14] The average yield is three-quarters to one and a half tons per hectare as compared with three and a half tons per hectare in the United States.

[15] See document GC(VII)/228, para. 68.

34. In co-operation with FAO, the Agency sponsored an International Training Course on the Use of Radiation and Isotopes in Entomology in Gainesville, Florida, from 7 October to 30 November 1963. The course was attended by 19 students from Africa, Asia, Europe and South America.

Plant breeding

35. Advances in knowledge about induced mutations in plant breeding have brought science to a point where it may be possible to devise means of inducing definite gene mutations and chromosome changes intentionally by the use of a combination of different kinds of radiation and chemical mutagens. The Agency is also taking steps to co-ordinate international work towards this aim.

36. It has been demonstrated recently that in some cases radiation can be used to induce beneficial changes in crop plants, some of which could not have been obtained with conventional methods. This has already resulted in a number of superior crop varieties (pea variety Sanilac in Michigan, barley variety Mari in Sweden). Since it is important that individual plant breeders in the developing countries should know how to use the techniques for the mutation method of breeding, the Agency has started the preparation of a Manual of Mutation Breeding.

37. The successful use of radiation-induced mutations in plant breeding gives rise to the hope that some serious problems of rice production can be solved by using mutation breeding methods. The Agency is taking steps to support research on this matter in view of the great importance of rice to most of the developing countries.

38. A number of developing countries have already acquired research reactors. These reactors are an important source of neutron irradiation for plant breeding purposes, and the Agency is encouraging their use for plant breeding work by organizing research work.

39. The Agency co-sponsored a Technical Meeting on the Use of Induced Mutations in Plant Breeding, which was organized by FAO in Rome at the end of May 1964. At this meeting scientists from many parts of the world realized the importance of the new breeding method for all crop plants while the as yet largely untapped potentialities of mutation breeding were emphasized.

Disease control

(i) Plants

40. Progress in the use of isotopes and radiation in plant pathology has been slow; the Agency therefore convened a panel of experts in September 1963 to study the problem. The panel recommended that, since there was a shortage of qualified scientists, especially in developing countries, the Agency should, wherever possible, support training requests, co-sponsor regional training courses and provide financial support for research on the use of isotopes and radiation in plant pathology.

(ii) Animals

41. Radiation provides the only known means of producing vaccines against diseases such as helminths, which affect both man and animals. These vaccines are produced by attenuating the virulence of helminthic larvae by subjecting them to ionizing radiation. In December 1963 the Agency convened a panel on the Production and Utilization of Radiation Vaccines against Helminth Diseases. The panel recommended that the Agency should, in close co-operation with FAO and WHO, make available funds for research contracts, provide training and fellowship exchange, hold meetings for exchange of information, employ consultants and maintain rosters of scientists working on radiation vaccines.

(b) Food irradiation

42. It is estimated that the amount of stored grain consumed or spoiled by insects would be sufficient to feed more than one hundred million people. Bacteria, moulds, yeasts and other organisms cause spoilage which costs several thousand million dollars a year. The

problem is especially acute in tropical and sub-tropical areas where, for instance, 25-60% of the fish caught and dried is lost as a result of insect attack.

43. In this context it is desirable to find the extent to which ionizing radiation can be used to reduce storage losses. In October and November 1963 the Agency made a comprehensive survey of the methods used to control insect pests in stored grain in Pakistan and indicated the possible use of radiation in the grain handling system. Technical assistance was also given to India in planning a programme of food preservation by irradiation. In March 1964 a similar study was begun in Turkey.

44. Following a meeting of a panel of experts held in Vienna in December 1962 on Irradiation Control of Harmful Organisms Transmitted by Food and by Feed Products [15], the Agency published a report [16] and has given research contracts to scientists in the Netherlands and Thailand. The Agency's programme lays stress on those applications that seem particularly promising for certain developing areas, such as disinfestation of grain [17] and control of salmonellae.

45. Research contracts on factors influencing the radiosensitivity of food spoilage micro-organisms were awarded to institutes in Belgium, Greece, India, Japan and the United Kingdom; this work is being co-ordinated with the Agency's radiobiology programme which also deals with radiation sensitivity mechanisms in biological systems.

3. Radiation biology

46. Radiation biology - the study of the effects of irradiation on living beings - is a large and rapidly advancing science. The knowledge being acquired makes it possible to modify or prevent the harmful effects of irradiation and opens up new prospects for the use of irradiation. During the period under review the biological effects of neutron irradiation, the modification of radiosensitivity and the toxic effect of ingested radionuclides were among the main activities of the Agency.

47. Following a Symposium at Harwell, United Kingdom, in December 1962, on Neutron Detection, Dosimetry and Standardization, and a panel discussion on methods of standardization and intercomparison of neutron measuring instruments [18], in October 1963 the Agency held a Symposium on Biological Effects of Neutron Irradiation at the Brookhaven National Laboratory in the United States. Dosimetry of neutrons in biological material, relative biological effectiveness of neutrons and protons, acute and chronic radiation syndromes and delayed consequences were discussed at this meeting. It was followed by a panel on Biophysical Considerations in Neutron Experimentation at which the problem of relative biological effectiveness was extensively discussed in view of the importance this question has for the formulation of adequate health and safety regulations.

48. Thirteen research contracts in radiation biology were awarded or renewed in 1963 in 11 countries from Agency funds, and two were renewed under the United States/Agency Joint Research Programme.

49. In view of the need for a comprehensive and up-to-date radiation shielding handbook, the Agency is giving its support to the publication of an Engineering Compendium on Radiation Shielding. This will cover problems that arise in the use of all types of penetrating ionizing radiation in connection with industrial, scientific and medical applications of nuclear energy.

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[16] Technical Reports Series No. 22, Radiation Control of Salmonellae in Food and Feed Products.

[17] Irradiation has the advantage over chemical fumigation that it sterilizes the egg as well as the insect.

[18] See document GC(VII)/228, para. 86.

CHAPTER II. RESEARCH AND SERVICES IN THE PHYSICAL SCIENCES

50. Besides its work on applications of radioisotopes in hydrology and chemistry, the Agency takes a close interest in the developments of fundamental disciplines, especially physics development insofar as they are related to nuclear energy.

1. Hydrology

51. It is now generally acknowledged that isotope techniques are making a substantial contribution to the solution of water problems encountered in the development of water resources. The growing interest in the potential value of these techniques has been reflected during the past year by the increased number of requests for advice and assistance from the Agency.

52. The Agency has already established an advisory and experimental service for the application of isotope techniques in dealing with problems relating to the development of water resources. In some cases it has been necessary to visit countries to determine the extent to which isotope techniques may usefully be employed; the turnover rate of Lake Chala in Kenya and possible sub-surface connections between this lake and a number of springs is being investigated. The Agency has also helped to set up a tritium laboratory in Rhodesia to use naturally occurring tritium in solving local hydrological problems. The staff who will be responsible for the running of this laboratory have been trained at the Agency's Laboratory in the analytical techniques to be employed.

53. Another type of application is illustrated by the field experiments carried out with a view to tracing the movement of silt in the Tonle Sap Great Lake region of Cambodia. These experiments are part of the international project for the development of the Lower Mekong River Basin. It has been shown that the quantity of silt involved would not seriously affect the construction of a dam. A joint French/Agency team has also demonstrated the use of radioisotopes for gauging rivers in Tunisia.

54. The Agency is serving as a sub-contractor under the United Nations Special Fund project in the Antalya region of Turkey where radioisotopes are being used to study the flow of groundwater: besides the field work involved, the Agency's Laboratory facilities are being used for the analysis of samples. [19] Sub-contractual work is also being done under a Special Fund project in Jordan: the tritium concentration of water samples from different points in three aquifers is being measured to obtain information on the age and rate of recharge of the water.

55. Consideration is being given to the development of other methods besides those already being applied in the field. Under the research contract programme, for example, the use of C^{14} for dating groundwater is being studied in an attempt to extend the range of ages of groundwater beyond those at present ascertainable by tritium measurements. Help is also being given to promote the use of radioisotopes to measure the velocity of groundwater in boreholes, the use of naturally occurring tritium to determine important groundwater parameters and the application of methods to enrich tritium.

56. Particular attention has been given in the Laboratory to the setting up of equipment for the enrichment and analysis of tritium. Routine methods have been developed to the extent that about 28 samples can now be analysed per month. This analytical capacity is being used to measure precipitation samples in the Agency/WMO world-wide survey of the concentration of oxygen and hydrogen isotopes in rainwater and also to measure groundwater samples in connection with the study of hydrological problems. As part of this work the Agency has been providing tritium standards for the purpose of intercomparison with other laboratories.

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[19] Also acting as a sub-contractor under a Special Fund project that is being executed by FAO, the Agency completed, in 1963, a study of groundwater connections in the Peloponnese in Greece.

2. Chemistry

57. The main work in chemistry and chemical techniques during the period under review covered:

(a) Thermodynamics of nuclear materials;

(b) Chemistry research and chemical techniques (including isotope production) with research reactors; and

(c) Industrial applications of radioisotopes and large radiation sources.

This work is designed to assist Member States and individual institutions by providing evaluated information and data in particular areas of chemistry, and by giving proper guidance for drawing up chemistry programmes relating to reactors, radioisotopes and large radiation sources.

Thermodynamics of nuclear materials

58. Together with nuclear data, thermodynamic and other physico-chemical data constitute the fundamental elements of knowledge needed in advanced nuclear technology. Thus, in work relating to the design of advanced types of reactors and the chemical reprocessing of spent fuels, thermodynamic data, especially in high-temperature regions, and a knowledge of the vaporization processes of nuclear materials are essential. However, reliable thermodynamic data are often lacking, especially in high-temperature regions; there is therefore a serious need to assess currently available thermodynamic data and to identify areas where data are lacking or further investigation is needed. The first panel to assess thermodynamic data of uranium-carbon and plutonium-carbon systems was convened in October 1962. [20] The second panel to assess the thermodynamic properties of another important fuel - uranium dioxide - was convened in March 1964. Uranium dioxide has been widely used as a reactor fuel, but much has yet to be learned of its fundamental physico-chemical properties. The second panel assessed not only the thermodynamic data but also transport and other physico-chemical properties. The report of this panel will contain a set of the most reliable data on uranium dioxide and also indicate areas needing further investigation.

Reactor-based chemistry research

59. One of the main parts of a research reactor programme comprises chemistry research and the development of chemical techniques particularly to produce isotopes at the reactor. As has been stressed at the Agency's Study Group Meetings in Bangkok, Athens, São Paulo and Manila [21], isotope production is especially important to the new reactor centres in developing countries.

60. Such centres encounter several difficulties in drawing up their programmes particularly due to the lack of information on current isotope production processes and of internationally acceptable standards of purity.

61. The Agency has accordingly started work on an experimental manual on isotope production. The manual is designed especially to meet the needs of the new centres and will give information on production processes currently being used at advanced reactor centres and the views of leading experts on this subject. Two experts of the Agency also visited Turkey in January 1964 to advise the Turkish reactor centre on its isotope production programme and the layout of its laboratory.

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[20] See document GC(VII)/228, para. 54.

[21] See also Chapter III, paras. 100-102.

Radioisotopes for research and practical applications

62. Although radioisotopes have many useful applications in fundamental and applied sciences as tracers or as radiation sources, their effectiveness as tracers is based on the fact that their chemical behaviour is almost identical to that of the normal stable isotope in association with which the tracer is used. However, this identity of behaviour is influenced by the difference in mass between the stable and the radioactive isotope. The study of the effect of mass differences on chemical behaviour is therefore of much interest.

63. The international survey on the use of radioisotopes in industry, which the Agency started in 1962, has met with a good response, and many of the more advanced Member States submitted reports on present applications in industry and savings achieved. The contents of these reports were discussed at a Study Group Meeting on Radioisotope Economics at the Agency's Headquarters in March 1964. Comparisons were made between the findings reported by the various countries and recommendations were made to the Agency to remove certain obstacles to an increased use of radioisotopes and to promote international co-operation in this field. In accordance with these recommendations the Agency is preparing a world-wide review of the economic significance of the industrial uses of radioisotopes.

3. Physics

Transient techniques

64. In recent years there has been a growing interest in transient - as opposed to static - techniques employed in neutron and reactor physics research. To reflect these trends two new subjects have been introduced into the Agency's programme. These are pulsed neutron research and statistical methods of studying fission chain fluctuations (reactor noise analysis and the Rossi-alpha method). Besides their research applications, these methods offer excellent possibilities for neutron and reactor physics training at relatively low cost and hence are expected to be of great interest to developing countries wishing to start or expand their training and research facilities at minimum cost. An up-to-date review of pulsed neutron research has been prepared and is being published in the Agency's technical journal, Atomic Energy Review.

Nuclear data

65. The compilation, evaluation and dissemination of basic nuclear data is an activity to which the Agency has a unique opportunity to contribute significantly. In recent years a wealth of new detailed information on the fundamental process of fission has appeared which is essential for a deeper understanding of all fission chain reactors and, in particular, of the sophisticated power-breeder reactors which will play a vital role in permitting the earth's nuclear fission energy reserves to be fully exploited. There is at present a need for an up-to-date authoritative review of allfundamental fission data, and at the same time an incentive to further research in fission physics and chemistry.

66. It is planned that the Agency's Nuclear Data Unit will at first concentrate on data on slow neutrons and the resonance region, and co-operate with other major compilation centres in exchanging numerical data and bibliographical references. A critical survey of nuclear cross-section data is being prepared by the Nuclear Data Unit for presentation at the forthcoming Third International Conference on the Peaceful Uses of Atomic Energy. This will include a digest of current data compilations with special emphasis on materials of general interest in reactor design, such as fuel, moderators, structural materials, etc.

Solid state physics

67. New developments with lithium-drifted germanium solid state detectors at the Chalk River Laboratories in Canada have provided gamma-ray detectors with very high-energy resolution and with a sensitivity some four or five orders of magnitude higher than

conventional magnetic devices of comparable resolution. Thus it will be possible for the first time to perform high-resolution coincidence studies even with low-power research reactors. This would mean that a real breakthrough in the case of neutron-captured gamma data can be expected during the next year.

68. An Agency research contract has been granted to the Institute of Nuclear Research, Swierk, Poland, to develop a new time-of-flight technique for crystallographic and solid state studies. This "variable-lambda" technique appears to hold considerable promise as a solid state physics research tool for use with low-power research reactors in the developing countries.

International Centre for Theoretical Physics

69. The agreement between the Government of Italy and the Agency for the establishment of an International Centre for Theoretical Physics at Trieste was signed in Rome on 11 October 1963. [22] After consultation with the Italian Government, Professor Abdus Salam (Pakistan), Imperial College, London, was appointed Director of the Centre. The appointment of the other scientific staff and the selection of the fellows is now in progress, and it is expected that the Centre will start operating in October 1964. The Scientific Council of the Centre met for the first time on 28 May 1964 and discussed the organization and operation of the Centre and the programme and activities planned for the academic year 1964-65. Members of the Council are: Professor Sandoval Vallarta, Chairman (Mexico), Professor Oppenheimer (Princeton), Professor Abdus Salam and Professor Weisskopf (CERN); Professor Sanielevici from the Agency is Secretary of the Council. The principal purpose of the Centre is to foster, through training and research, the advancement of theoretical physics, with special regard to the needs of the developing countries, so as to help and encourage theoretical physicists from these countries to continue and expand their research work.

[22] INFCIRC/51 and Corr. 1.

CHAPTER III. NUCLEAR POWER AND NUCLEAR TECHNOLOGY

1. The economics of nuclear power

70. There is accumulating evidence of the increasing role that nuclear power is likely to play in the world's electricity production, largely because of the significant fall in its capital and fuel costs.

71. The capacity of nuclear stations in operation by the beginning of 1964 was already substantial (3900 MW(e)) but the rate of nuclear expansion will rise in the next 15 years. The details of national or regional plans are given in Table I below from which the general conclusion can be drawn that between 1970 and 1980 25 to 30% of all new electric capacity will be nuclear.

Table I

Introduction of electric power plants, 1960-1980[a/]

Region	1960-70			1970-80		
	Total electric power MW(e)	Proportion of atomic power		Total electric power MW(e)	Proportion of atomic power	
		MW(e)	%		MW(e)	%
United States of America	150 000	5 000	3.3	190 000	38 000	20
Canada	25 000	1 000	4	28 000	5 000	18
United Kingdom	40 000	5 000	13	65 000	12 000	18
Belgium, France, Federal Republic of Germany, Italy. Netherlands	55 000	4 000	7	115 000	30 000	26
Other European countries	20 000	1 500	7	46 000	5 000	11
Others (including India, Japan and Pakistan)	60 000	4 000	6.7	100 000	10 000	10
Total	350 000	20 500	6	544 000	100 000	18

a/ The Soviet Union has an extremely large electric power development programme, designed to bring total installed capacity to a range of 180 000-200 000 MW by 1970 and to 540 000-600 000 MW by 1980. The share of nuclear power in this programme is however not yet finally defined, although it is known that several thousand megawatt of nuclear capacity will be brought into operation by 1970.

72. A number of commercial nuclear power plants and prototypes has gone into operation in France, Italy, the Soviet Union, the United Kingdom and the United States and the total nuclear installed capacity increased from 2680 MW(e) in June 1963 to 4100 MW(e) in June 1964. Table II gives the number, types and status of nuclear power stations in Member States currently in operation, under construction or planned for commissioning during the present decade. The graph that follows Table II shows the growth of installed nuclear capacity in Member States from 1960 on, with projections to the end of the decade.

Table II

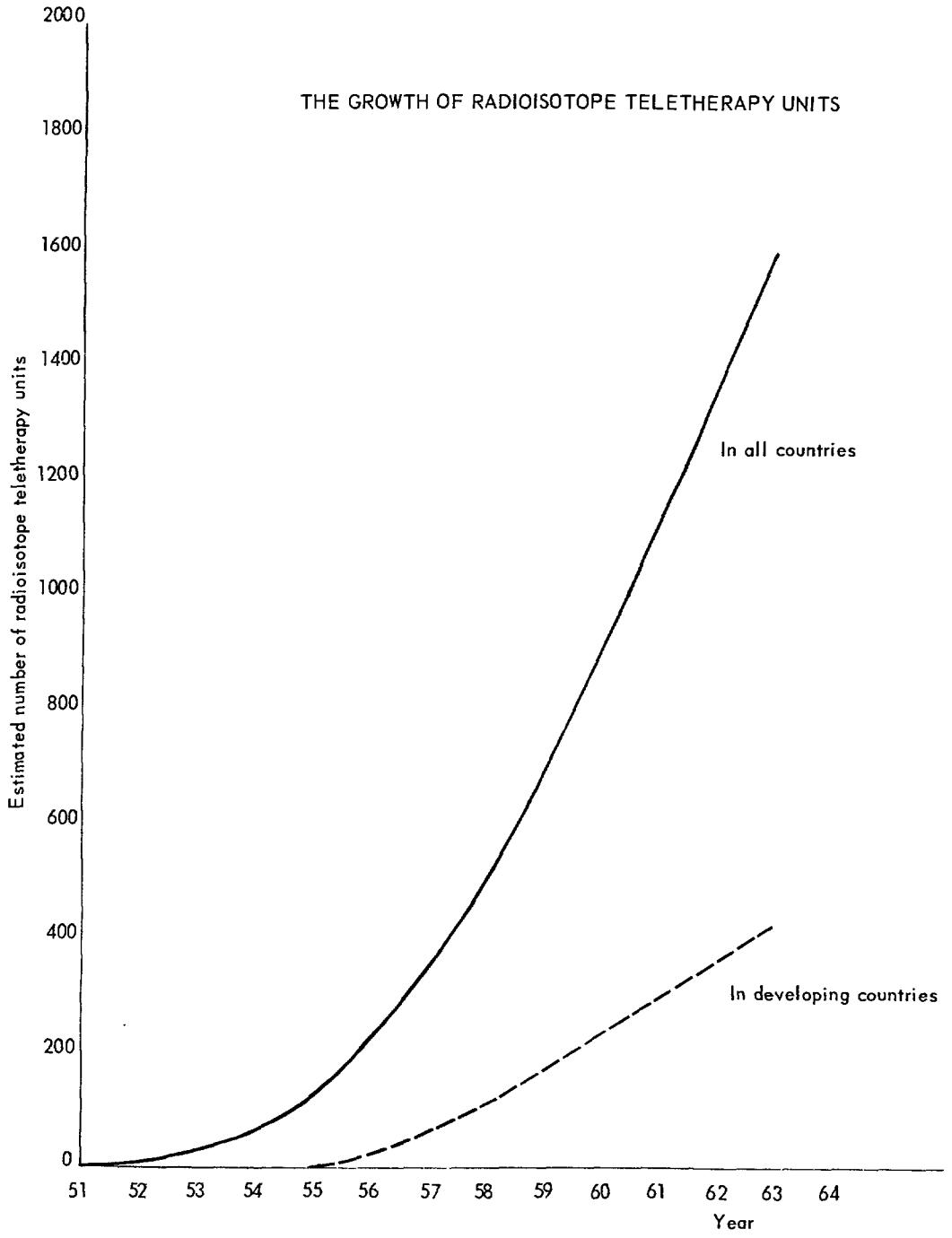
Name	Location	Type	Net output MW(e)	Criticality date
A. Power reactors in operation, March 1964				
(1) Belgium				
BR-3	Mol	Press. H_2O, 3.7 + 4.4% U	10.5	Aug 1962
(2) Canada				
NPD	Des Joachims	Press. D_2O, nat. U	19.3	Apr 1962
(3) France				
G-1	Marcoule	Nat. U, graphite, air	1.7	Jan 1956
G-2 (G-3)	Marcoule	Nat. U, graphite, CO_2	2 x 28	Jul 1958/June 1959
EDF-1	Chinon	Nat. U, graphite, CO_2	68	Sep 1962
(4) Germany, Federal Republic of				
KAHL	Kahl/Main	Boiling H_2O, 2.6% U	15	Nov 1960
(5) Italy				
LATINA	Latina	Nat. U, graphite, CO_2	200	Dec 1962
SENN	Sessa Aurunca	Boiling H_2O, 2% U	150	June 1963
(6) Japan				
JPDR	Tokai-Mura	Boiling H_2O, 2.5% U	11.7	Aug 1963
(7) Sweden				
R-3/ADAM	Agesta	Press. D_2O, nat. U	9	Jul 1963
(8) United Kingdom				
CALDER HALL	Calder Hall	Nat. U, graphite, CO_2	4 x 45	May 1956/Dec 1958
CHAPELCROSS	Chapelcross	Nat. U, graphite, CO_2	4 x 45	Oct 1958/Dec 1959
DFR	Dounreay	Fast breeder, 45.5% U, NaK	15	Nov 1959
BERKELEY	Berkeley	Nat. U, graphite, CO_2	2 x 138	Aug 1961/Mar 1962
BRADWELL	Bradwell	Nat. U, graphite, CO_2	2 x 150	Aug 1961/Apr 1962
AGR	Windscale	2.5% U, graphite, CO_2	27.3	Aug 1962
HUNTERSTON	Hunterston	Nat. U, graphite, CO_2	150	Sep 1963

Name	Location	Type	Net output MW(e)	Criticality date
(9) United States of America				
EBWR	Lemont	Boiling H_2O, 1.5 + 90% U	4.5	Dec 1956
SM-1	Fort Belvoir	Press. H_2O, 93% U	1.9	Apr 1957
SRE	Santa Susana	Graphite-sodium, 90% U + Th	5.1	Apr 1957
SHIPPINGPORT	Shippingport	Press. H_2O, nat. + 93% U	60	Dec 1957
DRESDEN	Dresden	Boiling H_2O, 1.5% U	208	Dec 1959
YANKEE	Rowe	Press. H_2O, 3.4% U	175	Aug 1960
PM-2A	Greenland	Press. H_2O, 93% U	1.5	Oct 1960
BORAX-5	Idaho Falls	Nucl. superheat, 5 + 93% U	2.7	Feb 1962
PM-1	Sundance	Press. H_2O, 93% U	1.0	Feb 1962
PM-3A	Antarctica	Press. H_2O, 93% U	1.5	Mar 1962
SM-1A	Alaska	Press. H_2O, 93% U	1.7	Mar 1962
SAXTON	Saxton	Press. H_2O, 5.7% U	3.3	Apr 1962
INDIAN POINT	Indian Point	Press. H_2O, 93% U + Th	255	Aug 1962
HNPF	Hallam	Sodium-graphite, 3.6% U	75	Aug 1962
BIG ROCK POINT	Charlevoix	Boiling H_2O, 3.2% U	47.8	Sep 1962
ERR	Elk River	Boiling H_2O, 93% U + Th	20	Nov 1962
HUMBOLDT BAY	Eureka	Boiling H_2O, 2.6% U	48.5	Feb 1963
CVTR	Parr	Press. D_2O, 1.5 + 2.0% U	17	Mar 1963
PNPF	Piqua	Organic, 1.9% U	11.4	Jun 1963
ENRICO FERMI	Lagoona Beach	Fast breeder, 25%+ nat. U	60.9	Aug 1963
EBR-2	Idaho Falls	Fast breeder, 49%+ nat. U, Na	16.5	Nov 1963
NPR	Richland	0.9% U, graphite, H_2O	776	Dec 1963
(10) Union of Soviet Socialist Republics				
APS	Obninsk	5% U, graphite, H_2O	5	May 1954
SIBERIAN	Troitak	Nat. U, graphite, H_2O	100 (600?)	Sep 1958/Dec 1962
URAL	Beloyarsk	Nucl. superheat, 1.3% U	94	Sep 1963
WWER	Voronezh	Press. H_2O, 1.5% U	196	Dec 1963

Name	Location	Type	Net output MW(e)	Criticality date
B. Power reactors under construction, March 1964				
(1) Belgium				
SENA	Chooz	Press. H_2O, 3.1% U	266	1965
(2) Canada				
CANDU	Douglas Point	Press. D_2O, nat. U	200	1964
(3) Czechoslovak Socialist Republic				
HWGCR	Bohunice	Nat. U, D_2O, CO_2	150	1970
(4) France				
EDF-2	Chinon	Nat. U, graphite, CO_2	198.5	1964
EDF-3	Chinon	Nat. U, graphite, CO_2	375	1965
EL-4	Monts d'Arrée	Enr. U, D_2O, CO_2	80	1966
SENA (see under Belgium)				
(5) Germany, Federal Republic of				
AVR	Jülich	Pebble bed, 20% U, graphite, He	13.2	1964
KRB	Grundremmingen	Boiling H_2O, enr. U	237	1966
MZFR	Karlsruhe	Nat. U, Press. D_2O	50	1965
(6) Germany, Eastern				
REINSBERG	Stechlinsee	Press. H_2O, 1.5% U	70	1964
(7) India				
TARAPURA	Tarapura	Boiling H_2O	2 x 190	1966
(8) Italy				
SELNI	Trino Vercellese	Press. H_2O, 2.6% U	270	1964
(9) Japan				
TOKAI-MURA	Tokai-Mura	Nat. U, graphite, CO_2	157	1965
(10) Sweden				
R-4/EVA	Marviken	Boiling D_2O, nat. U	200	1968
(11) Switzerland				
LUCENS	Lucens	1% U, D_2O, CO_2	7	1965
(12) United Kingdom				
HINKLEY POINT	Hinkley Point	Nat. U, graphite, CO_2	2 x 248	1964
HUNTERSTON	Hunterston	Nat. U, graphite, CO_2	160	Apr 1964
TRAWSFYNYDD	Trawsfynydd	Nat. U, graphite, CO_2	2 x 250	1964

Name	Location	Type	Net output MW(e)	Criticality date
DUNGENESS	Dungeness	Nat. U, graphite, CO_2	2 x 275	1964/65
SIZEWELL	Sizewell	Nat. U, graphite, CO_2	2 x 289	1965
OLDBURY	Oldbury	Nat. U, graphite, CO_2	2 x 280	1966
SGHWR	Winfrith	1.4% U, D_2O, boiling H_2O	100	1967
(13) United States of America				
PATHFINDER	Sioux Falls	Nucl. superheat, 2.2 + 93% U	58.5	Mar 1964
BONUS	Punta Higuera	Nucl. superheat, nat. + 3% U	16.3	Apr 1964
EGCR	Oak Ridge	2.5% U, graphite, He	21.9	1965
HTGR	Peach Bottom	93% U + Th, graphite, He	40	1965
LACBWR	Genoa	3.4% U, boiling H_2O	50	1965
(14) Union of Soviet Socialist Republics				
ULYANOVSK	Ulyanovsk	Boiling H_2O, 1.5% U	50	1964
WWER	Voronezh	Press. H_2O, 1.5% U	196	1965
URAL	Beloyarsk	Nucl. superheat, 1.3% U	94 (200?)	1964
C. Power reactors planned				
(1) Brazil				
Guanabara	Guanabara	Nat. U, graphite, CO_2	300	1969
(2) Canada				
HWR 1800	Toronto	Press. D_2O, nat. U	4 x 450	1970
(3) China				
Keoshiung	Keoshiung		200	1971
(4) France				
EDF-4	Saint Laurent des Eaux	Nat. U, graphite, CO_2	600	1967
(5) India				
INDIAN CANDU	Rana Pratap Sagar	Press. D_2O, nat. U	200	1967
(6) Japan				
TSURUGA	Tsuruga	Press. or boiling H_2O	300	1968

Name	Location	Type	Net output MW(e)	Criticality date
(7) Pakistan				
HWR 132	Karachi area	Nat. U, press. D_2O	132	1968
East Pakistan	Rocpur	Boiling H_2O	50	1968
(8) Spain				
ZORITA DE LOS CANES	Zorita de los Canes	Press. H_2O	140	1966
BILBAO-EBRO	Tobalina		250	1968
CASTREJON	Castrejon		250	1968
(9) United Arab Republic				
ALEXANDRIA	Alexandria		150	
(10) United Kingdom				
WYLFA	Wylfa	Nat. U, graphite, CO_2	2 x 500	1968
(11) United States of America				
BODEGA BAY	Bodega Bay	2.7% U, boiling H_2O	313	1966
S. Cal. Ed.	Camp Pendleton	3.6% U, press. H_2O	375	1966
Connect. Yankee	Haddam Neck	3-4% U, press. H_2O	463	1967
LADWPR	Malibu Beach	3.8% U, press. H_2O	463	1968
NINE MILE POINT	Oswego N.Y.	Boiling H_2O	500	1968
JERSEY CENTRAL	Oyster Creek, N.J.	Boiling H_2O	515	1968



73. It is noteworthy that the developing countries are taking an increased interest in nuclear power. India has started the construction of a 380 MW station at Tarapur and signed a contract for another 200 MW reactor in Rajisthan, while announcing the plans for a third similar unit in southern India. Pakistan has invited bids for a 70 MW station for East Pakistan and a 132 MW plant for West Pakistan. Brazil has invited proposals for two nuclear power plants, and the United Arab Republic is also planning to build its first nuclear power station.

74. An important factor is that economic estimates have now become sufficiently firm to permit dependable long-term planning. The firm offer made to a United States power company for a 515-600 MW reactor, capable of competing with a conventional station using coal at ¢ 26/ million BTU, as well as the declared intention of several manufacturers to quote a list of prices for nuclear stations over a wide range of sizes, bear witness to the new status of nuclear power. These developments have brought to the fore a number of tasks requiring the Agency's attention. These tasks may be grouped into three main categories:

(a) To prepare a reasonably dependable picture of the present cost situation for different reactor systems;

(b) To help develop suitable methods for the economic comparison of nuclear and conventional power stations and power programmes; and

(c) To help developing and other countries that are about to introduce nuclear stations in selecting the most suitable type of plant and deciding the most appropriate timing for their construction.

75. As regards the first task, apart from the continuing studies carried out by the Agency on this subject the Third International Conference on the Peaceful Uses of Atomic Energy is expected to devote special attention to the basic technological and cost data and prospects for the main reactor types already proven or under active development.

76. The second category of problems will become particularly important as the total component of nuclear stations in the output of existing power systems grows. Having completed the economic investigation of the generating costs of nuclear stations considered in isolation, the Agency has now proceeded to prepare a report dealing with the economic assessment of nuclear power within the framework of the electricity production and supply systems in which it is expected to be integrated. [23]

77. Finally, the assistance of the Agency to developing countries has taken a variety of forms according to the diverse needs of the requesting States. A preliminary report on the feasibility of nuclear power in Thailand has been issued. [24] A preliminary power mission was sent to the Republic of Korea in October 1963 and its report is now being prepared. At a more advanced stage advice has been sought from the Agency by the Government of Pakistan in evaluating the bids for two proposed nuclear stations in that country.

78. In the Philippines the Agency is serving as the Executing Agency for a United Nations Special Fund Project entitled Pre-investment Study on Power, including Nuclear Power, in Luzon. This project was formally launched in February 1964 when the Project Agreement was signed. The first year will be devoted to the assessment of all available indigenous conventional energy resources to meet the projected demand for power during the next ten years. If this indicates that the country will have to depend upon importation of fuel from abroad, a detailed comparison will be made between various conventional and nuclear plants during the second year of the Study. The methodology developed through this study will be useful for other developing countries also in analysing the possible role of nuclear power.

2. Technical aspects of reactor development

79. The pressurized and boiling-water reactors have reached a stage of advanced industrial development and are being regarded as "conventional nuclear plants". A boiling-water reactor - Big Rock Point Plant in the United States - has already achieved a net efficiency of 34% which is close to that of conventional steam stations. The future development of these reactors will be towards high power density cores and large single-unit plants of the size of 1000 MW. The next generation may include nuclear superheat. During the last year, three nuclear superheat water reactors - Borax V and VESR in the United States and Kurchatov in the Soviet Union - went into operation and are expected to yield very valuable data on the behaviour of nuclear superheating fuel elements.

80. The Magnox gas-cooled reactors are performing very well. The Bradwell reactor has produced some three million MW/h and Berkeley two million MW/h. Calder Hall and Chapelcross reactors have operated with 99% availability factors over the winter period. The total power generated by these reactors over eight years is more than 16 million MW/h. The AGR (Advanced Gas-Cooled Reactor) has operated successfully since February 1963. In

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[23] Technical Reports Series, Report on the Economic Aspects of the Integration of Nuclear Power Plants in Electric Power Systems (in print).

[24] Report of an Agency Mission to Thailand, M.62.15/Rev.1.

the case of reactors of the HTGR (High-Temperature Gas-Cooled Reactor) type, the requisite fuel technology is advancing significantly and the experiments show that the ceramic-coated fuel particles could withstand high temperatures and yield very high burn-ups, i.e. up to 90 000 MWd/t.

81. Operating experience with water reactors as well as gas-cooled reactors has been most encouraging and the various stations have performed well beyond their original design ratings. The availability factors have exceeded 95% and two stations - Dresden and Yankee in the United States - have already produced over three thousand million kWh.

82. The technology of heavy-water reactors is developing rapidly and operating experience from NPD (Canada), CVTR (United States) and AGESTA (Sweden) is very encouraging. Several countries have announced plans for the construction of natural uranium heavy-water plants.

83. The PIQUA small organic-moderated nuclear power station in the United States is operating at full power. Although the organic reactor programme in the United States has been sharply reduced, there is widespread interest in the development of heavy-water moderated organic-cooled reactors.

84. The first sodium-cooled nuclear power plant (at Hallam, United States) has been operating at full power. Further development in this concept may involve the use of uranium carbide fuel.

85. Breeder reactors are receiving increased attention but they are still in the experimental stage. The experience resulting from such plants as BR-5 (Soviet Union), Dounreay (United Kingdom) and Fermi (United States) is providing essential physical and technical data for future construction of prototypes. Since the Dounreay reactor first produced electricity in October 1962, it has generated more than 24 000 MW/h of electricity for use in the United Kingdom National Grid in addition to serving as an experimental facility.

86. Progress is also being made towards dual-purpose nuclear power plants which could provide electricity and low-temperature heat for desalination, space heating and other industrial applications. The AGESTA reactor in Sweden is already supplying steam for household heating.

87. Four years of experience with the Soviet icebreaker Lenin and the initial experience with the United States nuclear ship Savannah have demonstrated the technical feasibility of nuclear ship reactors. Several countries have announced plans for the construction of prototype commercial nuclear ships.

88. The Agency has been closely following the important developments in nuclear power technology enumerated above and part of its current work is the preparation of the scientific programme for the Third International Conference on the Peaceful Uses of Atomic Energy, which will be primarily devoted to the latest technological and economic developments in nuclear power. Most of the papers submitted to the Conference will deal with power reactors and provide valuable new data that has come to light since the second Conference in 1958.

89. The Agency is also continuing to study the experience resulting from the design, construction and operation of a number of nuclear power stations in Canada, the United Kingdom and the United States. This arrangement enables developing Member States, through the Agency, to keep in close touch with the actual progress of nuclear power in these countries. At present the arrangement covers nine power reactors representing eight different systems. It is hoped that, with the co-operation of other Member States, this coverage can be extended to several more such projects and a world-wide view on nuclear power technology can thus be presented. Information on the projects is gathered by visits to the reactor sites and discussions with the reactor designers, manufacturers and operators as well as the national atomic energy authorities. Annual reports on these projects have been published for the last three years and one is being prepared for publication in the last quarter of 1964.

90. Physics and materials problems of reactor control rods were discussed in a symposium held in Vienna in November 1963. The efficiency of present techniques and prospects for future developments were reviewed and summarized in a panel discussion. It was stressed during this panel discussion that the majority of checks were carried out in small experimental assemblies, which did not reproduce the conditions actually pertaining to power reactors in operation. Fullest use should therefore be made of practical operating experience, and participants appealed to reactor operators to make information as widely accessible as possible so as to further control rod development.

91. A Conference on New Materials Technology including Non-metallic Fuel Elements was held in Prague in July 1963. It stressed the value of work being done to develop new materials - and especially non-metallic fuels such as uranium and plutonium carbides - for various reactors in order to improve their performance and reduce power costs. It was also stressed that the main advantage of the non-metallic fuels is that their higher melting point permits the operation of a reactor at a higher temperature than is possible with metallic fuels. This in turn tends to give a higher efficiency in the utilization of the heat for the generation of electric power.

92. In order to discuss basic problems relating to reactor shielding design for research and power reactors, the Agency convened a panel of experts in March 1964. The panel reviewed the current status of theoretical and practical research and plans for future work in reactor shielding in various countries, and discussed several suggestions which could lead to significant reductions in the reactor shielding costs.

93. A Symposium on Exponential and Critical Experiments was held in Amsterdam in September 1963. This symposium discussed the role of such experiments in developing optimum designs for power reactor cores. Among other things it was stressed that the organic-cooled heavy-water moderated reactor seemed to be one of the promising type of the heavy-water family of reactors.

94. Several experimental reactors utilizing plutonium have been built or are planned and the Agency is very much aware of the potential significance of the utilization of plutonium for power reactors and the influence which credit for plutonium may have on nuclear power economics. With this in view studies are being undertaken on the prospects of plutonium utilization in power reactors, and a panel will be convened towards the end of 1964 to advise on the formulation of future programmes.

3. Application of nuclear energy to desalting

95. Shortage of fresh water may become one of the most urgent problems to many countries in the near future. It is generally estimated that about 60% of the land surface of the world is dry and classed as "extremely arid, arid or semi-arid". There are also many other regions that suffer from water shortage: many islands, for instance, have very small supplies of groundwater and depend entirely on rainfall. Certain over-populated areas have to pay a very high price for their water supply.

96. Nuclear power as a means of producing fresh water from salt water could help to solve this problem of water shortage. It could be applied to any of the different water purification processes by supplying the heat or electricity to operate the process. In March 1963 a group of five consultants discussed the use of nuclear reactors for the desalination of water and made recommendations on the possible future programme of the Agency in this field. [25] At a second meeting in September 1963 it was pointed out that nuclear plants with the dual purpose of power generation and saline water conversion offer certain economic advantages over plants designed solely for desalination in situations where substantial demands for power exist.

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[25] See document GC(VII)/228, para. 43.

97. Meanwhile, at the invitation of the Government of Tunisia, an Agency expert has studied the possibilities of using nuclear power to produce both electricity and desalinated water in southern Tunisia. [26]

98. Intensive work is also under way in some countries, especially in the United States, on the study of technical aspects of dual-purpose plants. A third meeting of a panel of experts was convened by the Agency in April 1964 in order to help co-ordinate these studies and bring together experience gained and results obtained. The Agency is thus making arrangements to follow the development of this work and to review technological progress in desalination studies every six months. In February 1964 it published a technical report [27] giving some information on the present status of desalination and the possible role that nuclear energy may play in this field.

4. Promotion of co-operation in reactor research

99. The Agency is enlarging its activities for promoting effective utilization of research reactors, especially in the developing countries, where such facilities represent the first major step towards atomic energy programmes.

100. During the past year the Agency organized three Study Group Meetings on Research Reactor Utilization in different parts of the world; one for the Mediterranean region was held at Athens in September 1963; another for Latin America at São Paulo in November 1963. The third meeting, at Manila in December 1963, for the Far Eastern and Southern Asian countries was a follow-up of the Bangkok meeting of December 1962 and it dealt with the more restricted topics of reactor operations and isotope production.

101. The results showed once more the value of such informal meetings in stimulating research reactor utilization work in the respective regions. It has been found that the study group meetings permit the attendance of a considerable number of scientists within the region and offer the possibility of concentrating on problems of special interest to reactor centres which are in similar phases of development. They also help in the exchange of experience and promote closer contact among the scientists in the area. In these meetings emphasis has been on discussions rather than presentation of papers and informal records of the meetings have been issued for the information of the centres concerned.

102. These study group meetings have also proved a useful instrument for promoting international collaboration. The contact established among the scientists within a given region paves the way for bilateral and multilateral arrangements among the various reactor establishments in the region as well as with advanced centres outside. Since the Athens meeting, for example, a small group of countries having the same type of research reactors has begun to explore means of close scientific collaboration with the help of the Agency, which can assist in arranging the exchange of scientists between them.

103. A five-year joint project in Asia and the Far East under the auspices of the Agency involving the use of a neutron crystal spectrometer was approved by the Board in June. [28] India had offered the necessary equipment and the Philippines has agreed to serve as host. The Agency is to allocate up to five fellowships and to arrange for the participation of at least one outside scientist at all times throughout the programme. The reactor centres in the area are also proposing to publish a periodic newsletter summarizing major activities connected with research reactor utilization.

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[26] A study of the use of conventional power to make fresh water available in southern Tunisia by desalination was also undertaken by the United Nations. The Government of Tunisia was thus provided with advice on the conventional as well as the nuclear power solution to its water shortage problem.

[27] Technical Reports Series No. 24, Desalination of Water using Conventional and Nuclear Energy.

[28] For the text of the agreement see document INFCIRC/56.

104. In Latin America the possibility is being considered of a joint project involving the use of a liquid nitrogen loop of the type in use at the Grenoble Centre in France. This would be useful for advanced training and research in solid state physics, radiation chemistry and hot atom chemistry.

105. Among the topics that appear to be particularly suitable for co-operation between laboratories are the standardization of pile dosimetry techniques, the investigation of radiation sensitivity of seeds and the application of pile radiation to induce particular mutations.

106. The Agency is planning two more study group meetings for the latter half of 1964, one at Bucharest and another in South Asia; it is also compiling a manual on the Operation of Research Reactors.

107. The three-year Joint Research Programme on reactor physics between the Agency and the Government of Norway, which included the study of fundamental reactor physics problems relating to the use of D_2O and H_2O/D_2O mixtures as a moderator, was successfully completed in April 1964. The second phase of this programme will be carried out over another period of three years under the NORA project extension agreement. [29]

108. An agreement between the Agency and the Governments of Norway, Poland and Yugoslavia concerning co-operative research in reactor physics [30] (the NPY-project) provides for theoretical and experimental investigations of basic problems of reactor physics by co-ordinating the research programmes of the three countries and establishing closer liaison among the national research institutions involved, thus making more effective use of their joint resources in the planning, implementation and interpretation of research in fields that are of great interest to all parties to the agreement.

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[29] For the text of this agreement, see document INFCIRC/29/Add.2, part III.

[30] INFCIRC/55.

CHAPTER IV. HEALTH, SAFETY AND WASTE MANAGEMENT

109. The growth in the number of nuclear facilities in the world requires increasing work by the Agency in the field of health and safety and waste management. Guidance in the form of safety standards and technical manuals or by the provision of technical advice on particular projects, co-ordination of the activities concerned with health and safety hazards, and co-ordination of international research were the Agency's main concern in this field during the period under review.

1. Regulatory work and dissemination of information

110. There is a continuing need for the Agency to provide, and to keep under review, safety standards to be applied to its own operations and to the increasing number of projects to which it provides assistance. Such standards are also useful to Member States as a basis on which their national systems of standards and regulations can be established and developed. The Agency has also a part to play in encouraging the co-ordination of national and international standards in the field of radiological protection, and the distribution of information on specific topics related to radiological protection is another important part of the Agency's work.

111. During the period under review, panels of experts have been convened to revise the Agency's Regulations for the Safe Transport of Radioactive Materials in consultation with many international organizations concerned and, in collaboration with the International Organization for Standardization, to develop and standardize packaging tests; to consider the question of permissible emergency doses to the public, as an extension of the Agency's basic safety standards for radiation protection; and to complete the work of panels which met during the previous year on the drafting of codes of practice, on the provision of radiological protection services and for personnel monitoring.

112. Panels of experts were also convened to prepare manuals of guidance on environmental monitoring in emergency situations and on the control of air pollution in the operation of nuclear facilities, and to discuss the application of mineral reactions to waste treatment.

113. In November 1963 a joint Agency/WHO/FAO Seminar on the Protection of the Public in the Event of Radiation Accidents was convened in Geneva. The various problems associated with the contamination of persons, food and agricultural resources were reviewed and consideration was given to the scientific basis for assessing risks involved in exposure to radiation and in weighing these against the risks of possible preventive and protective measures.

114. In May 1964 a joint Agency/ILO/WHO Symposium on the Assessment of Radioactive Body Burdens in Man was held at Heidelberg. The symposium was concerned with the estimation of internal contamination and particular emphasis was given to the difficult problem of interpreting the results of measurements and assessing the whole body or organ doses.

115. The Agency also collaborated with ENEA in a study of safety standards for radioactive luminous dials for watches and clocks.

116. Following the work done by several panels on waste disposal into the sea and into fresh water, consideration is being given to the problem of ensuring that the requirements of public health and safety are met in the arrangements for certain categories of disposal of radioactive waste into water. These studies are being undertaken in pursuance of the mandate to take whatever action is necessary to assist States in controlling the discharge or release of radioactive materials to the sea given to the Agency by the Conference on the Law of the Sea which was held in Geneva in 1958.

2. Services to Member States

117. Advice and short-term assistance provided by the Agency's staff to Member States provide a useful supplement to the general technical assistance programme. This help may take the form of investigating problems submitted by Member States, evaluating requests

for more substantial Agency support, providing advice and assistance on technical matters, or organizaing training courses for scientific and administrative personnel.

118. Steps have been taken to develop a special health and safety and waste management advisory service. Member States will be invited to submit specific problems arising in their radiological protection and waste management programmes, and the Secretariat will endeavour to provide practical advice. The co-operation of other international organizations is being sought in order to extend the range of problems the advisory service can cover.

119. Several advanced Member States have agreed to provide cost-free experts to review the safety of movements of irradiated fuel that may be submitted to the Agency for advisory assessment. Pending the completion and acceptance of Agency standards for irradiated fuel casks, this service should considerably facilitate the approval of such shipment by the competent authorities concerned.

120. The Agency's staff provided advice to Sudan on techniques for the measurement of the radioactive contamination of the atmosphere and assisted in the setting-up and initial operation of the measuring equipment. Advice was also provided to Tunisia on the organization of a radiological protection control programme.

121. An international training course on bio-assay of radionuclides, attended by ten candidates from widely distributed Member States, was held at the Agency's Laboratory in November 1963.

122. Work has continued on the safety evaluation of requests for Agency assistance and on the application of the Agency's Health and Safety Measures to assisted projects. As a consequence of the growing number of research and power reactors the Agency is paying particular attention to the safety aspects of the design and operation of reactors as well as the disposal of radioactive wastes.

3. Emergency assistance

123. Despite the precautions taken in the operation of nuclear facilities it must be accepted that accidents will occasionally occur in which persons may be exposed to radiation or the surroundings may be contaminated as a result of the uncontrolled release of radioactive material. A country in which a serious radiation accident has occurred may not have sufficient experience or may not possess the resources necessary to deal with all the consequences of such an accident and would therefore require help from other countries. The Agency can play a useful role in facilitating and co-ordinating the provision of the necessary assistance at an international level.

124. Information has been collected and distributed to all Member States, on the nature of the assistance that individual States may be prepared to make available on request. Member States have also been informed that the Agency is prepared to act as an intermediary in transmitting requests for, or offers of, assistance, and to send staff members to the site of an accident to participate in the emergency operations, or as observers.

125. The Nordic Mutual Emergency Assistance Agreement in connection with Radiation Accidents was signed by the Governments of Denmark, Finland, Norway and Sweden and the Agency on 17 October 1963. [31] The agreement covers such points as financial provisions, liability, list of the authorities which may request and receive assistance, use of information obtained in connection with the help given, and the special functions of the Agency. Member States have been invited to consider the negotiation of similar agreements in other regions.

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[31] INFCIRC/49.

4. Research on radiation protection and waste management

126. The Agency's regulatory work and its services to Member States in the field of health and safety must be based on the best available scientific knowledge and it is thus necessary to stay abreast of current research. The Secretariat therefore keeps in close touch with scientific organizations such as ICRP and ICRU, as well as other international organizations such as ILO and WHO. A Symposium on Radiological Health and Safety in Nuclear Materials Mining and Milling, jointly sponsored with ILO and WHO, was held in August 1963 in Vienna; it covered all the main aspects involved in the protection against occupational health risks in the mining and milling of nuclear materials, ranging from the purely medical and technical sides of the problem of radiological protection to the management of radioactive waste materials and to the evolution of health standards and of their enforcement. It is also part of the Agency's work to help its Member States in the safe and economic management of radioactive wastes, and to encourage the development and improvement of waste management procedures. These procedures are, in general, related to the treatment and storage of high-level wastes, to the separation of intermediate-level wastes into high-level and low-level components, and to the controlled and safe dispersal of low-level wastes into various sectors of the natural environment.

127. The amount of money the Agency can offer for the support of research is very small in comparison with the resources for research and development in waste management in some of the advanced countries. With the aim of drawing more heavily upon the national research programmes the Agency convened a panel in February 1964. This considered the way in which the Agency could co-ordinate the exchange of information on waste management research and make the results more readily available to all Member States. The results of the meeting were encouraging and a plan was proposed which would enable the Agency to play a useful co-ordinating role.

CHAPTER V. SAFEGUARDS

128. The Agency has continued to apply its safeguards in connection with Agency projects to reactors in Finland (FiR-1: Triga II), Norway (NORA) and the Congo (Leopoldville) (TRICO: Triga I). Safeguards will similarly be applied to reactors in Mexico (Triga III), Pakistan (AMF) and Yugoslavia (Triga II) as soon as the reactors are constructed or fuel for them is delivered.

129. Under its agreement for the application of safeguards to four United States reactor facilities [32], the Agency carried out inspections in November 1963 and May 1964 of the Brookhaven Graphite Research Reactor and of the Piqua Reactor; the Brookhaven Medical Research Reactor was also inspected in May. The provisions with regard to safeguards on the Argonne Experimental Boiling Water Reactor had automatically terminated on 1 June 1963, whereas those with respect to the three reactors mentioned above expired on 1 June of this year. However, with respect to those three reactors, the Agency and the United States signed a new agreement [33] on 15 June providing for the application of full safeguards for a period of five years. In addition, the same agreement also covers the 600 MW(t) Yankee Reactor in Rowe, Massachusetts, the first facility to which the Agency's new safeguards provisions for large reactor facilities [34] will apply.

130. Until this year the reactors subject to Agency safeguards, apart from those voluntarily submitted by the United States to assist the Agency in developing its safeguards system [32], have been of very low power. The transfer to the Agency of the responsibility for safeguarding 13 reactors and nuclear materials that had previously been safeguarded under the terms of the Japan/United States bilateral agreement represents a first step not only in the transformation of bilateral safeguards into truly international ones but also in the application of Agency safeguards to reactors of a greater power and hence a much greater possible military significance than hitherto. The trilateral agreement regarding this transfer [35] was signed on 23 September 1963, and entered into force on 1 November 1963 for a period of four years. Under this agreement the Agency is presently applying safeguards to the equipment, devices and nuclear materials which were subject to United States safeguards in Japan. These include two medium-size reactors and the nuclear materials in them as well as 11 small reactors and critical facilities. The first safeguards inspection in Japan was carried out in May.

131. In June the Board approved four further trilateral agreements for the transfer to the Agency of the administration of safeguards under bilateral agreements of co-operation between the United States and Austria, Greece, Norway and the Philippines, respectively. Each of the new agreements, whose texts are substantially identical, provides for an "umbrella" type safeguards arrangement, under which the items to be safeguarded are not specified in the agreement itself but will cover all facilities, equipment or materials transferred by the United States to the four countries under the bilateral agreements, as well as all special fissionable material produced by their use (or material substituted therefor) whether such material remains in the country in which it was produced or is transferred to the United States.

132. The Agency was also informed in September 1963 by the Governments of Japan and the United Kingdom of their readiness to enter into consultations with the Agency with a view to formulating an appropriate agreement concerning the transfer to the Agency of the administration of the safeguards under their bilateral agreement of 16 June 1958 for co-operation in the peaceful uses of atomic energy. Such an agreement would cover the application of safeguards to the Tokai-Mura nuclear power station, which is expected to become critical in 1965 with a planned capacity of approximately 585 MW(t). Similar information has recently been received concerning the bilateral agreement between the United States and Viet-Nam.

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[32] INFCIRC/36.

[33] INFCIRC/57.

[34] INFCIRC/26/Add.1.

[35] INFCIRC/47.

133. The Governments of Israel and South Africa have informed the Agency that a certain quantity of uranium oxide has been delivered to Israel which, together with a previous delivery [36], will bring the total quantity in that State up to 10 metric tons of PN natural uranium within the meaning of paragraph 21 of document INFCIRC/26.

134. The proposed extension of the Agency's safeguards system to reactors of more than 100 thermal megawatts, of which the General Conference had taken note in its Resolution GC(VII)/RES/144, was put into effect on 26 February 1964. [34] In this connection the Board also established a Working Group, in which all Board Members may be represented, to undertake a general review of the Agency's safeguards system in the light of the actual experience gained by the Agency and of the technological development which has taken place, and giving particular attention to the provisions relating to the attachment of safeguards to equipment. The Working Group held a short organizational meeting on 28 February, and began its work on 20 May, at which time it studied the views communicated by Member States with regard to the Agency's safeguards system. It then requested its chairman to prepare, in collaboration with the Secretariat, a preliminary draft of a new safeguards document, and decided to meet again to consider this draft at the end of October 1964.

135. The objective of the Agency's safeguards system being to detect the diversion for military purposes of nuclear materials and facilities dedicated to peaceful uses, it is necessary to develop appropriate methods for such detection. Research contracts were awarded for methods of determining independently the power output of a reactor, for the positive identification of fuel elements by a "fingerprinting" system so as to reduce the possibility of the clandestine use of the fuel and for non-destructive analysis of irradiated fuel so as to check quickly whether the fuel contains the amount of fissionable material corresponding to the power produced. A Panel on the Non-destructive Analysis of Irradiated Fuel Elements was organized by the Agency in October 1963 in Hercegnovi, Yugoslavia, at which the practicability of non-destructive spectrometric methods of analysis for the safe and economic operation of reactors as well as for the efficient performance of safeguards controls were discussed. A research contract was placed for the study of photographic identification schemes on fuel elements.

136. A panel on nuclear materials management was held in June 1964 in which experts from countries advanced in the development of nuclear power exchanged views on management problems relating to nuclear materials and discussed the agenda for a proposed symposium to be held in 1965 on nuclear materials management. The panel considered reactors as well as other facilities in the nuclear fuel cycle.

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[36] See document GC(VII)/228, para. 114.

CHAPTER VI. TECHNICAL ASSISTANCE AND OTHER SERVICES

137. A full report on the technical assistance provided by the Agency in 1963 is being submitted separately. [37] The main trends are summarized in the paragraphs below.

138. As in previous years the demands on the programme in 1963 have continued to grow and exceeded the resources available. Voluntary contributions from Member States fail to reach the target, and the financing of the Agency's regular technical assistance programme continues to be a serious problem. For 1963, $1 437 394 were pledged for a target of $2 million. Pledges for voluntary contributions for 1964 only reached $1 229 756 by 30 June 1964. Data on Agency funds for technical assistance is given in the table below:

Item	1959 $	1960 $	1961 $	1962 $	1963 $
Target for voluntary contributions to the General Fund	1 500 000	1 500 000	1 800 000	2 000 000	2 000 000
Amount pledged	1 183 044	996 103	1 261 570	1 380 470	1 435 394
Budgeted for technical assistance	1 100 000	1 367 000	1 361 000	1 625 000	1 799 000
Funds available for technical assistance	875 133	1 007 842	980 881	1 146 294	1 230 000

139. The monetary resources available for technical assistance increased slightly from $1 989 553 in 1962 to $2 149 400 in 1963 mainly as a result of a somewhat larger EPTA allocation. It should be noted that the requests made by Member States in connection with the 1963 programme, and consequently also the projects approved and the assistance provided, reflect the increased sophistication of the nuclear energy programmes of many of the developing Member States.

140. The only noteworthy trends from 1962 to 1963 in the various components of the technical assistance programmes (regular and EPTA) were a decline in the resources allotted to fellowships and an increase in those allotted to equipment.

141. The services of experts and visiting professors provided in 1963 were of a value of $585 400 and $135 500 respectively. Taking account of similar services offered in connection with training courses and the Agency's mobile radioisotope laboratories, the total value of such services in 1963 was $798 600.

142. The value of equipment provided by the Agency to 32 countries was $468 600. Taking into account, in addition, equipment made available to certain international projects the total equipment element within the Agency's technical assistance programme amounted to $513 400. This element constituted 22% of the total programme financed from the Agency's own resources (7.5% in 1962 and 14.4% in 1961); under the EPTA programme the equipment element rose to 28.7% (18.7% in 1962 and 7.5% in 1961).

143. The value of fellowships awarded by the Agency in 1963 was $1 006 500, while the value of research fellowships was $17 000. This amount covered the cost of 295 regular fellowships (EPTA: 30; Type I: 132; Type II: 133) and of 104 fellowships to short-term training courses and 13 to research grantees. In addition students were trained in the Agency's two mobile radioisotope laboratories, and some fellowships were awarded under Special Fund projects.

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[37] GC(VIII)/INF/72.

144. During the period under review the Agency organized training courses as part of its technical assistance programme. The data on these courses are shown in Table III below:

Table III

Date	Title	Country
1963		
17 Jun to 25 Jul	General Training Course on Agricultural Methods[a]	United Arab Republic (Cairo Centre)
28 Jul to 5 Sep	International Training Course on Nuclear Science for High School Teachers[b]	Israel
12 Aug to 2 Dec	Regional Training Course on the Applications of Radioisotopes in Medicine[a]	Argentina
2 Sep to 31 Jan	Advanced International Training Course on the Physics of Radiotherapy	United Kingdom
5 Oct to 28 Nov	Special Training Course in Agriculture[a]	United Arab Republic (Cairo Centre)
7 Oct to 30 Nov	International Training Course on the Use of Radiation and Isotopes in Entomology[c]	United States
30 Sep to 25 Nov	Regional Training Course on the Application of Radioactive Isotopes in Soil-plant Relations[a]	Turkey
21 Oct to 29 Nov	Regional Training Course on Scientific Documentation Techniques[d]	India
4 Nov to 2 Dec	International Training Course in Bio-assay Procedures	Austria (Seibersdorf)
1964		
13 Jan to 30 Jun	Inter-regional Training Course on the Maintenance and Repair of Nuclear Electronic Equipment	Ceylon
7 Mar to 26 Jun	Training Course in Medicine	United Arab Republic (Cairo Centre)
20 Apr to 6 Jun	Advanced Inter-regional Training Course on the Cellular and Molecular Aspects of Radiobiology	Israel (Radioisotope Training Centre near Rehovoth)
4 May to 18 Sep	International Refresher Course on Nuclear Physics for University Teaching Staff in Developing Countries	Denmark

a/ Financed by EPTA.

b/ The Agency's only contribution was the payment of 50% of the travel expenses of 11 foreign participants.

c/ Co-sponsored with FAO.

d/ Co-sponsored with UNESCO.

145. The Agreement for the Establishment in Cairo of a Middle Eastern Regional Radioisotope Centre for the Arab Countries entered into force on 29 January 1963. [38] During 1963 the Centre received $28 558 from EPTA through the Agency which was spent for fellowships ($11 358), equipment ($7110) and visiting professors ($10 093). In addition the host country contributed 25 000 Egyptian pounds (approximately $80 500), while six participating Arab States pledged a total contribution of $13 500.

146. An interesting new feature in the Agency's technical assistance programme was the appointment during 1963 of two regional advisers. One of them, whose assignment includes advice to institutions in nine countries in the Middle East, started his advisory work on hospital physics in April 1963. His main concerns have been the physical aspects of the use of radiation for therapeutic purposes, including radiation dosimetry and protection, the training of personnel, the planning of buildings and advice in the selection of equipment; his work has been performed in collaboration with governmental authorities and radiotherapy centres being planned or already in operation and with the WHO East-Mediterranean Regional Office. A second expert took up his duties in October 1963 in the Far East to assist in various Agency programmes involving research on improved methods of the cultivation of rice.

147. Technical assistance to improve documentation services in developing Member States has been continued during the period under review. Experts, scientific publications, microfilming and micro-reading apparatuses and other documentation equipment have been provided to Member States at their request. Fellowships for training in documentation and library services have been granted.

Library services

148. The Agency's library now has a collection of 26 032 volumes, 64 036 reports, 742 journal titles and 250 films. During the year the library circulated 1545 items to other libraries and lent 404 films.

149. A booklet has been distributed to Member States listing the services available to them. These now include reference and photocopying services, a fellowship training programme as well as film and interlibrary loans.

[38] INFCIRC/38 and Add.1/Rev.1.

CHAPTER VII. ADMINISTRATION

1. External relations

Relations with the United Nations and the specialized agencies

150. In June 1963 ECOSOC adopted Resolution 986 (XXXVI) on the co-ordination of atomic energy activities whereby it recalled the main statutory responsibilities of the Agency, affirmed that the Agency should act as the primary sponsor, in co-operation where appropriate with the specialized agencies, of activities in which atomic energy or research relating thereto forms the major part of the subject matter, and called for more effective co-ordination in atomic energy matters.

151. The Council's requests were noted by the General Conference [39] which requested the Board and the Director General to take such further steps as might be necessary to ensure co-ordination at the earliest possible stage in the development of Agency programmes and projects. The Director General accordingly approached his colleagues in those specialized agencies whose work or interests come most closely into contact with those of the Agency. He had discussions with the Director General of WHO in Geneva in November 1963 and among the various points on which agreement was reached was the appointment of technical liaison officers, on a trial basis, by each agency at the headquarters of the other.

152. In February 1964 the Director General met the Director General of FAO in Rome when they agreed to study the practical problems involved in establishing a joint division in Vienna, consisting of members of both Secretariats, as soon as possible after 1 July 1964. As a first step, technical liaison officers were appointed by both organizations to serve at the headquarters of the other. The Board welcomed the Director General's efforts to achieve co-ordination at the Secretariat level, and expressed the hope that they would be matched at the Government level.

153. Sections of the Agency's draft programme for 1965-66 were sent to ILO, FAO, UNESCO and WHO for comment before being submitted to the Board. Intersecretariat consultations on this programme, the programmes of ILO and WHO and on other matters of interest subsequently took place in March 1964.

154. The first meeting of the intersecretariat working group established between UNESCO and the Agency took place in November 1963. It reviewed in particular the arrangements for co-operation in research, training and scientific abstracts between the two organizations. Consultations are also taking place regarding the form of UNESCO's participation in the International Centre for Theoretical Physics which is being established by the Agency in Trieste.

155. In implementation of General Conference Resolution GC(VII)/RES/155, co-operation with the United Nations in matters of energy and power has been intensified. A member of the Agency staff has been outposted to work with the Energy and Electricity Unit of the United Nations Resources and Transport Branch, an arrangement which is proving to be of advantage to both organizations. In the Special Fund Pre-investment Study on Power, including Nuclear Power, in Luzon, in the Philippines, for which the Agency is acting as Executing Agency, the United Nations is the sub-contractor for those aspects of the project dealing with investigation of coal deposits, geothermal energy resources and oil prices.

Regional matters

156. An agreement for co-operation between the Agency and CTCA was signed on 6 February 1964 [40] after the draft agreement had been approved by the General Conference [41].

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[39] Resolution GC(VII)/RES/149.

[40] INFCIRC/25/Add.1.

[41] Resolution GC(VII)/RES/141.

157. The Agency has continued to co-operate with organizations such as ENEA and IANEC, particularly to ensure co-ordination of regional and international work on civil liability and, in the case of ENEA, on various health, safety and waste management regulations. The Agency also helped IANEC to carry out a survey of nuclear power prospects in Latin America.

158. To improve the Agency's operational contacts with its Member States in Asia, the Director General has appointed, on an experimental basis, a regional officer for Asia and the Far East. The duties of this regional officer are to follow the national atomic energy programmes of the 16 Member States in the region (as well as several EPTA eligible non-Member States) to advise on the development of such programmes and especially to help plan and carry out technical assistance projects. This officer, who is based in Bangkok, Thailand (location of the Headquarters of ECAFE and also of the Regional Representative of TAB and Director of Special Fund Programmes in Far East Asia) took up his duties in November 1963. It is planned that this post will be filled in rotation by specialists in the various branches of atomic energy, thus attempting to meet successively the various needs of the region.

2. Personnel

159. On 30 June 1964 the staff of the Agency was composed of 247 staff members in the Professional category and above, and 339 in the General Service category. The number of nationalities represented among that section of staff which is subject to geographical distribution was 45.

3. Finance

Regular Budget for 1963

160. The assessment of contributions for 1963 of Member States included in the scale of assessment for that year amounted to $7 122 500; this was subsequently increased to $7 155 263 by the assessment of eight new Members (Algeria, Bolivia, Ivory Coast, Liberia, Libya, Saudi Arabia, Syrian Arab Republic, Uruguay).

161. By 31 December 1963 the Agency had received contributions towards the Regular Budget for 1963 amounting to $6 159 521, which represents 86.08% of the total assessment. By 30 June 1964 $6 647 569 or 92.90% of the total contributions due had been received towards the Regular Budget for 1963. [42]

162. The obligations for 1963 amounted to $6 893 613 which resulted in budgetary savings of $443 887 from the appropriations for 1963. A further $80 652 from miscellaneous income and assessments on new Member States brought the total budgetary surplus at 31 December 1963 to $524 539, as follows:

Budgetary savings	$443 887
Miscellaneous income	47 889
Assessments on new Member States	32 763
Budgetary surplus for 1963	$524 539

Although the budgetary surplus for 1963 was $524 539, contributions outstanding for the same year amounted to $995 741, leaving a provisional cash deficit of $471 202.

163. Unliquidated obligations in respect of 1963 appropriations at 31 December 1963 were $812 334, of which $312 000 had been liquidated by 30 June 1964.

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[42] See Annex II, part B, which shows outstanding contributions to the 1958, 1959, 1960, 1961, 1962 and 1963 Regular Budgets.

164. In October 1963 the Board authorized the transfer of up to $12 000 from Section 5 - Seminars, symposia and conferences - to Section 3 - Panels and committees - to meet the cost of regional study groups not originally provided for in the 1963 budget, which however turned out not to be necessary because of savings in Section 3. As regards the authorization to make further transfers up to $5000 in any one section of the Regular Budget, an amount of $1883 was transferred from Section 6 - Distribution of information - to Section 12 - Common services, equipment and non-technical supplies - to cover an unforeseen expenditure amounting to $2549 to meet expenses for cable relay services which had been previously provided by the United Nations free of charge.

Regular Budget for 1964

165. By 30 June 1964 the following advances to the Working Capital Fund and contributions to the Regular Budget for 1964 had been received:

Advances to the Working Capital Fund	$2 001 600
Contributions to the 1964 Regular Budget	$2 436 754

By that date Member States had thus paid 99.68% of the total advances due to the Working Capital Fund and 33.62% of the total contributions due to the 1964 Regular Budget. [43]

Operational Budget

166. Of a total amount of $1 435 394 pledged to the General Fund for 1963, $659 697 had been paid by 31 December 1963. By June 1964 the total pledged was increased to $1 437 394 and receipts amounted to $1 192 797, leaving a balance of $244 597 still to be paid. With regard to the target of $2 million set for 1963 by the General Conference at its sixth regular session, there was a shortfall of approximately $565 000 in the actual pledges made by Member States.

167. The total operational obligations incurred during 1963 amounted to $1 562 192. Unliquidated obligations at 31 December 1963, including obligations brought forward from previous years, amounted to $1 079 344.

168. The total amount pledged to the General Fund for 1964 at 30 June 1964 was $1 229 756 of which $399 244 had been paid by that date. [44]

4. Legal matters

169. Four further instruments of acceptance of the Agreement on the Privileges and Immunities of the Agency were deposited with the Director General. By 30 June 1964, twenty States had become parties to the Agreement.

170. As a result of the recommendation made by the General Conference at its seventh regular session concerning the Vienna Convention on Civil Liability for Nuclear Damage [45], the Director General was informed by a number of States that the ratification of the Convention was under consideration.

171. The Standing Committee on Civil Liability for Nuclear Damage met in Vienna from 13 to 17 April. It considered questions related to the Convention mentioned above, including those referred to it by the resolution adopted by the Vienna Conference on 19 May 1963, and reached agreement on certain problems relating to the application of the Convention.

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[43] Ibid., parts A and C.

[44] Ibid., part D.

[45] Resolution GC(VII)/RES/156.

172. The Standing Committee established by the Brussels Diplomatic Conference on Maritime Law in May 1962 completed, in two series of meetings from 24 to 31 October 1963, and from 24 June to 1 July 1964, the consideration of three problems related to the 1962 Convention on the Liability of Operators of Nuclear Ships which had been referred to it by the Conference, and reported thereon in accordance with its mandate, to the Belgian Government and the Agency.

ANNEX I

THE BOARD OF GOVERNORS

To 1 October 1963	1963 - 1964	From 1 October 1963
		Afghanistan[d]
	Argentina[a] [c]	
	Australia[b] [c]	
Belgium[e]		
	Brazil[f]	
	Canada[b] [c]	
		China[d]
Colombia[g]		
		Congo (Leopoldville)[d]
		Czechoslovak Socialist Republic[h]
Denmark[e]		
	France[b] [c]	
Greece[g]		
Hungary[g]		
	India[b] [c]	
	Indonesia[f]	
	Iran[f]	
	Italy[f]	
	Japan[b] [c]	
	Mexico[b] [c]	
		Morocco[d]
		Norway[h]
Pakistan[g]		
Poland[e]		
		Portugal[h]
		Romania[d]
	South Africa[b] [c]	
		Switzerland[d]
	Union of Soviet Socialist Republics[b] [c]	
	United Kingdom of Great Britain and Northern Ireland[b] [c]	

To 1 October 1963	1963 - 1964	From 1 October 1963
	United States of America[b/] [c/]	
		Uruguay[d/]
Viet-Nam[g/]		

a/ Designated by the Board on 16 July 1962 under Article VI. A. 1 of the Statute.

b/ Designated by the Board on 19 June 1962 under Article VI. A. 1 of the Statute.

c/ Designated by the Board on 21 June 1963 under Article VI. A. 1 of the Statute.

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

e/ Designated by the Board on 19 June 1962 under Article VI. A. 2 of the Statute.

f/ Elected by the General Conference on 26 September 1962 under Article VI. A. 3 of the Statute.

g/ Elected by the General Conference on 5 October 1961 under Article VI. A. 3 of the Statute.

h/ Designated by the Board on 21 June 1963 under Article VI. A. 2 of the Statute.

ANNEX II

FINANCE

A. Advances to the Working Capital Fund

Member	Assessed	Paid	Outstanding
	$	$	$
Afghanistan	1 000	1 000	-
Albania	800	800	-
Argentina	18 600	18 600	-
Australia	30 600	30 600	-
Austria	8 200	8 200	-
Belgium	22 200	22 200	-
Bolivia	800	800	-
Brazil	19 000	19 000	-
Bulgaria	3 600	3 600	-
Burma	1 200	1 200	-
Byelorussian Soviet Socialist Republic	9 600	9 600	-
Cambodia	800	800	-
Canada	57 600	57 600	-
Ceylon	1 600	1 600	-
Chile	4 800	4 800	-
China	84 400	84 400	-
Colombia	4 800	4 800	-
Congo (Leopoldville)	1 200	1 200	-
Cuba	4 000	4 000	-
Czechoslovak Socialist Republic	21 600	21 600	-
Denmark	10 600	10 600	-
Dominican Republic	1 000	1 000	-
Ecuador	1 200	1 200	-
El Salvador	800	800	-
Ethiopia	1 000	1 000	-
Finland	6 800	6 800	-
France	109 600	109 600	-
Germany, Federal Republic of	105 200	105 200	-
Ghana	1 600	1 600	-
Greece	4 200	4 200	-
Guatemala	1 000	1 000	-
Haiti	800	800	-
Holy See	800	800	-
Honduras	800	800	-
Hungary	10 400	10 400	-
Iceland	800	800	-
India	37 400	37 400	-
Indonesia	8 200	8 200	-
Iran	3 600	3 600	-
Iraq	1 600	1 600	-
Israel	2 800	2 800	-
Italy	41 400	41 400	-
Japan	41 800	41 800	-
Korea, Republic of	3 400	3 400	-
Lebanon	1 000	1 000	-

Member	Assessed	Paid	Outstanding
	$	$	$
Liberia	800	800	-
Luxembourg	1 000	1 000	-
Mali	800	800	-
Mexico	13 600	13 600	-
Monaco	800	800	-
Morocco	2 600	2 600	-
Netherlands	18 600	18 600	-
New Zealand	7 600	7 600	-
Nicaragua	800	800	-
Norway	8 200	8 200	-
Pakistan	7 800	7 800	-
Paraguay	800	-	800
Peru	1 800	1 800	-
Philippines	7 400	7 400	-
Poland	23 600	23 600	-
Portugal	3 000	3 000	-
Romania	5 800	5 800	-
Saudi Arabia	1 200	1 200	-
Senegal	1 000	1 000	-
South Africa	9 800	9 800	-
Spain	15 800	15 800	-
Sudan	1 200	1 200	-
Sweden	24 000	24 000	-
Switzerland	17 600	17 600	-
Syrian Arab Republic	1 000	-	1 000
Thailand	3 000	3 000	-
Tunisia	1 000	1 000	-
Turkey	7 400	7 400	-
Ukrainian Soviet Socialist Republic	36 600	36 600	-
Union of Soviet Socialist Republics	276 400	276 400	-
United Arab Republic	4 600	4 600	-
United Kingdom of Great Britain and Northern Ireland	140 000	140 000	-
United States of America	638 600	638 600	-
Uruguay	2 000	-	2 000
Venezuela	9 600	9 600	-
Viet-Nam	3 000	3 000	-
Yugoslavia	7 000	7 000	-
Total	2 000 000	1 996 200	3 800
New Members			
Algeria	1 800	-	1 800
Gabon	800	800	-
Ivory Coast	800	800	-
Libya	800	-	800
Nigeria	3 800	3 800	-
Total for new Members	8 000	5 400	2 600

B. Outstanding contributions to the 1958, 1959, 1960, 1961, 1962 and 1963 Regular Budgets

Member	1958	1959	1960	1961	1962	1963	Total
	$	$	$	$	$	$	$
Afghanistan	-	-	-	-	-	3 281	3 281
Algeria	-	-	-	-	-	6 410	6 410
Argentina	-	-	-	-	57 285	66 239	123 524
Bulgaria	-	-	-	-	-	4 166	4 166
Chile	-	-	-	-	-	15 431	15 431
China	-	-	-	-	294 964	301 282	596 246
Colombia	-	-	-	-	15 010	17 094	32 104
Congo (Leopoldville)	-	-	-	-	601	4 273	4 874
Cuba	-	-	-	10 794	15 111	14 245	40 150
Dominican Republic	-	-	-	2 261	3 316	3 561	9 138
Ecuador	-	-	-	-	-	3 863	3 863
El Salvador	-	-	-	-	-	2 322	2 322
Guatemala	-	-	-	-	2 478	3 561	6 039
Haiti	-	2 021	2 337	2 467	2 652	2 849	12 326
Honduras	1 635	2 090	2 337	2 467	2 652	2 849	14 030
Hungary	-	-	-	-	22 433	37 037	59 470
Libya	-	-	-	-	-	2 849	2 849
Nicaragua	-	-	-	2 035	2 652	2 849	7 536
Paraguay	1 636	2 090	2 337	2 467	2 652	2 849	14 031
Syrian Arab Republic	-	-	-	-	-	3 561	3 561
Uruguay	-	-	-	-	-	7 123	7 123
Total outstanding	3 271	6 201	7 011	22 491	421 806	507 694	968 474
Total paid	4 111 489	5 218 799	5 873 969	6 178 199	6 218 273	6 647 569	
Total assessed	4 114 760	5 225 000	5 880 980	6 200 690	6 640 079	7 155 263	
Percentage paid of assessment	99.92	99.88	99.88	99.64	93.65	92.90	

C. Contributions to the 1964 Regular Budget

Member	Assessed	Credits	Paid	Balance
	$	$	$	$
Afghanistan	3 610	-	-	3 610
Albania	2 888	81	-	2 807
Argentina	67 146	-	-	67 146
Australia	110 466	3 556	53 455	53 455
Austria	29 602	1 009	14 196	14 397
Belgium	80 142	2 426	77 716	-
Bolivia	2 888	-	2 000	888
Brazil	68 590	1 900	-	66 690
Bulgaria	12 996	-	-	12 996
Burma	4 332	142	4 190	-
Byelorussian Soviet Socialist Republic	34 656	869	-	33 787
Cambodia	2 888	81	-	2 807
Canada	207 936	6 022	201 914	-
Ceylon	5 776	182	5 594	-
Chile	17 328	-	-	17 328
China	304 684	-	-	304 684
Colombia	17 328	-	-	17 328
Congo	4 332	-	-	4 332
Cuba	14 440	-	-	14 440
Czechoslovak Socialist Republic	77 976	1 638	-	76 338
Denmark	38 266	1 332	36 934	-
Dominican Republic	3 610	-	-	3 610
Ecuador	4 332	-	-	4 332
El Salvador	2 888	-	-	2 888
Ethiopia	3 610	101	-	3 509
Finland	24 548	667	23 881	-
France	395 656	12 188	383 468	-
Germany, Federal Republic of	379 772	10 167	184 802	184 803
Ghana	5 776	121	5 655	-
Greece	15 162	425	-	14 737
Guatemala	3 610	-	-	3 610
Haiti	2 888	-	-	2 888
Holy See	2 888	81	2 807	-
Honduras	2 888	-	-	2 888
Hungary	37 544	-	-	37 544
Iceland	2 888	81	2 807	-
India	135 014	4 809	130 205	-
Indonesia	29 602	1 069	-	28 533
Iran	12 996	584	-	12 412
Iraq	5 776	162	5 614	-
Israel	10 108	263	9 845	-
Italy	149 454	4 205	-	145 249
Japan	150 898	4 304	146 594	-
Korea, Republic of	12 274	584	-	11 690
Lebanon	3 610	101	3 509	-

Member	Assessed	Credits	Paid	Balance
	$	$	$	$
Liberia	2 888	-	-	2 888
Luxembourg	3 610	101	3 509	-
Mali	2 888	81	2 807	-
Mexico	49 096	1 334	47 762	-
Monaco	2 888	81	2 807	-
Morocco	9 386	263	-	9 123
Netherlands	67 146	1 880	65 266	-
New Zealand	27 436	788	26 648	-
Nicaragua	2 888	-	-	2 888
Norway	29 602	1 110	28 492	-
Pakistan	28 158	748	27 410	-
Paraguay	2 888	-	-	2 888
Peru	6 498	202	-	6 296
Philippines	26 714	809	25 905	-
Poland	85 196	2 568	45 000	37 628
Portugal	10 830	384	10 446	-
Romania	20 938	827	10 369	9 742
Saudi Arabia	4 332	-	4 332	-
Senegal	3 610	101	3 509	-
South Africa	35 378	1 051	34 327	-
Spain	57 038	-	1 939	55 099
Sudan	4 332	101	4 231	-
Sweden	86 640	2 608	-	84 032
Switzerland	63 536	1 819	61 717	-
Syrian Arab Republic	3 610	-	-	3 610
Thailand	10 830	303	10 527	-
Tunisia	3 610	93	-	3 517
Turkey	26 714	1 112	-	25 602
Ukrainian Soviet Socialist Republic	132 126	3 376	-	128 750
Union of Soviet Socialist Republics	997 804	26 093	-	971 711
United Arab Republic	16 606	607	-	15 999
United Kingdom of Great Britain and Northern Ireland	505 400	14 756	490 644	-
United States of America	2 305 346	67 361	-	2 237 985
Uruguay	7 220	-	-	7 220
Venezuela	34 656	930	-	33 726
Viet-Nam	10 830	384	10 446	-
Yugoslavia	25 270	647	12 313	12 310
Sub-total	7 220 000	191 668	2 225 592	4 802 740
New Members				
Algeria	6 498	-	-	6 498
Gabon	2 888	-	2 888	-
Ivory Coast	2 888	-	2 888	-
Libya	2 888	-	-	2 888
Nigeria	13 718	-	13 718	-
Sub-total	28 880	-	19 494	9 386
Total	7 248 880	191 668	2 245 086	4 812 126

D. Voluntary contributions to the General Fund

(i) For 1964

Member	Contribution pledged (equivalent in United States dollars at Technical Assistance Board rates)	Paid $
Argentina	15 000	-
Australia	20 000	20 000
Austria	5 000	-
Brazil	19 000ab/	-
Burma	1 000	1 000
Canada	57 600b/	-
Ceylon	2 100ab/	2 100
China	5 000	5 000
Congo (Leopoldville)	333ad/	-
Denmark	10 600b/	10 600
Finland	6 800b/	6 800
Germany, Federal Republic of	105 200b/	52 600
Greece	4 200b/	-
Holy See	2 000b/	2 000
India	25 000a/	25 000
Indonesia	2 000	-
Israel	2 800ab/	2 800
Italy	c/	-
Japan	40 000	40 000
Korea, Republic of	3 000	-
Lebanon	1 000b/	1 000
Liberia	6 301b/	-
Mexico	13 600b/	13 600
Monaco	2 000b/	-
Morocco	2 600b/	-
Netherlands	18 600b/	18 600
Norway	8 200b/	-
Pakistan	6 000a/	6 000
Philippines	4 000a/	4 000
Portugal	3 600b/	3 600
South Africa	9 800b/	-
Sweden	24 000b/	-
Switzerland	17 600ba/	17 600
Thailand	3 000b/	-
Tunisia	1 000b/	-
Turkey	4 444a/	4 444
United Arab Republic	11 500ab/	11 500
United Kingdom of Great Britain and Northern Ireland	144 000ba/	144 000
United States of America	500 000e/	-
Yugoslavia	7 000ab/	7 000
	1 114 878	399 244
United States of America (matching contribution)	114 878	-
	1 229 756	399 244

a/ Pledge announced in local currency.

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

c/ The Italian Government is studying the possibility of offering a substantial voluntary contribution.

d/ Due to a change in the rate of exchange, Congo's pledge of 50 000 Congolese francs is now equivalent to $333.

e/ In addition, a matching contribution of dollar for dollar of the total contributions above $1 million, until a total of $1.5 million is reached.

(ii) For 1963

Member	Contribution pledged (equivalent in United States dollars at Technical Assistance Board rates)	Paid $
Argentina	15 000	-
Australia	20 000	20 000
Austria	5 000	5 000
Belgium	10 000	10 000
Brazil	19 000	19 000
Burma	1 000	1 000
Canada	57 800	57 800
China	5 000	5 000
Denmark	10 800	10 800
Finland	6 800	6 800
France	30 612	30 612
Germany, Federal Republic of	105 400	105 400
Ghana	2 500	-
Greece	4 200	4 200
Holy See	2 000	2 000
India	25 000	25 000
Indonesia	2 000	2 000
Iraq	2 000	2 000
Israel	2 222	2 222
Italy	41 400	41 400
Japan	28 000	28 000
Korea, Republic of	3 000	3 000
Lebanon	1 000	1 000
Mexico	13 000	13 000
Monaco	42 816	42 816
Morocco	2 600	2 600
Netherlands	18 600	18 600
Norway	8 400	-
Pakistan	6 000	6 000
Philippines	4 000	4 000
Portugal	3 600	3 600
South Africa	9 800	9 800
Sweden	24 000	24 000
Switzerland	16 203	16 203
Thailand	3 000	3 000
Turkey	4 444	4 444
United Arab Republic	11 500	11 500
United Kingdom of Great Britain and Northern Ireland	144 000	144 000
United States of America	500 000	500 000
Yugoslavia	7 000	7 000
	1 218 697	1 192 797
United States of America (matching contribution)	218 697	-
	1 437 394	1 192 797

ANNEX III

CONFERENCES, SYMPOSIA AND PUBLICATIONS

A. Conferences and symposia held in 1963

Date and place	Title	Co-sponsoring organizations	Number of participants	Number of countries represented	Number of organizations represented	Number of papers presented
5-9 March Tokyo	Symposium on the Application of Radioisotopes in Hydrology		95	14	5	27
11-15 March Bombay (India)	Symposium on Criteria for Guidance in the Selection of Sites for the Construction of Reactors and Nuclear Research Centres		120	12	5	29
22-26 April Athens	Symposium on the Use and Application of Radioisotopes and Radiation in the Control of Plant and Animal Insect Pests	FAO	97	26	5	36
27-31 May Salzburg (Austria)	Conference on the Application of Large Radiation Sources in Industry		192	24	1	41
4-8 June Vienna	Conference on Operating Experience with Power Reactors		239	27	6	40
1-5 July Prague	Conference on New Nuclear Materials Technology including Non-metallic Fuel Elements		151	23	4	61
26-31 August Vienna	Symposium on Radiological Health and Safety in Nuclear Materials Mining and Milling	ILO/ WHO	129	25	5	66
2-6 September Amsterdam (Netherlands)	Symposium on Exponential and Critical Experiments		198	29	3	68
7-11 October Brookhaven National Laboratory (United States of America)	Symposium on Biological Effects of Neutron Irradiations		128	17	4	54

Date and place	Title	Co-sponsoring organizations	Number of participants	Number of countries represented	Number of organizations represented	Number of papers presented
11-15 November Vienna	Symposium on Physics and Material Problems of Reactor Control Rods		102	19	2	33
9-13 December Vienna	Symposium on Isotope Mass Effects in Chemistry and Biology	In co-operation with the Joint Commission on Applied Radioactivity (JCAR) of ICSU	68	15	1	29

B. Symposium programme for 1964

Date	Title	Place	Co-sponsoring organizations
20-24 April	Symposium on Medical Radioisotope Scanning	Athens	
11-16 May	Symposium on Assessment of Radioactive Body Burdens in Man	Heidelberg (Federal Republic of Germany)	WHO/ILO
19-23 October	Symposium on Radiochemical Methods of Analysis	Salzburg (Austria)	
23-27 November	Symposium on the Use of Radioisotopes in Animal Nutrition and Physiology	Prague	FAO
7-11 December	Symposium on Chemical Effects Associated with Nuclear Reactions and Radioactive Transformations	Vienna	IUPAC
15-19 December	Symposium on the Inelastic Scattering of Neutrons	Bombay (India)	

C. Agency publications[a]

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

Biological Effects of Neutron and Proton Irradiations, two volumes
Exponential and Critical Experiments, three volumes
Industrial Uses of Large Radiation Sources, two volumes
New Nuclear Materials Including Non-Metallic Fuels, two volumes
Operating Experience with Power Reactors, two volumes
Physics and Material Problems of Reactor Control Rods
Radiation and Radioisotopes Applied to Insects of Agricultural Importance
Radioisotopes in Hydrology
Radiological Health and Safety in Mining and Milling of Nuclear Materials, two volumes
Siting of Reactors and Nuclear Research Centres

2. Technical Directories

Directory of Whole-Body Radioactivity Monitors
Radioisotope Applications in Industry

3. Safety Series

No. 10 Disposal of Radioactive Wastes into Fresh Water[c]

4. Bibliographical Series

No. 10 Photonuclear Reactions
No. 11 Chromatographic Separation of the Lanthanide and Actinide Elements

5. Technical Reports Series

No. 16 IAEA Research Contracts - Third Annual Report[d]
No. 17 Chemistry Research and Chemical Techniques Based on Research Reactors
No. 18 Analytical Chemistry of Nuclear Materials
No. 19 The Efficient Importation and Distribution of Radioisotopes[e]
No. 20 Heavy Water Lattices - Second Panel Report
No. 21 Insect Population Control by the Sterile-Male Technique
No. 22 Radiation Control of Salmonellae in Food and Feed Products
No. 23 Isotope Techniques for Hydrology
No. 24 Desalination of Water Using Conventional and Nuclear Energy
No. 25 IAEA Laboratory Activities - First Report
No. 26 Radiation Quantities and Units[d]
No. 27 Technology of Radioactive Waste Management Avoiding Environmental Disposal
No. 28 IAEA Research Contracts - Fourth Annual Report

6. Journals

Nuclear Fusion - Journal of Plasma Physics and Thermonuclear Fusion, Volume III, Nos. 2-4, Volume 4, Nos. 1 and 2
Atomic Energy Review, Volume 1, Nos. 3 and 4, Volume 2, Nos. 1 and 2
International Atomic Energy Agency Bulletin, four issues[f]

7. Miscellaneous

Conferences, Meetings, Training Courses in Atomic Energy, Nos. 25-31
List of References on Nuclear Energy, Volume 5, Nos. 13-24, Volume 6, Nos. 1-12
Publications in the Nuclear Sciences (Catalogue)g/

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a/ Published in English, unless otherwise indicated.

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

c/ Published in Russian and Spanish.

d/ Published in French, Russian and Spanish.

e/ Published in English, French and Spanish.

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

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

ANNEX IV

RESEARCH CONTRACTS

A. Total value of contracts in 1962 and 1963

Year	New contracts	Renewals	Total	Value[a/]
				$
1962	51	47	98	773 972
1963	56	58	114	770 757

a/ From the Agency's funds. In addition, 12 contracts to the value of $154 607 were renewed in 1962, and nine contracts to the value of $86 902 were awarded or renewed in 1963 from funds made available by the United States Government under the United States/Agency Joint Research Programme.

B. Analysis by subject matter of contracts awarded or renewed in 1963

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	5	8	131 386	-	131 386
Health physics and radiation protection	5	18	141 960	-	141 960
Radiobiology	10	3	83 850	-	83 850
Safeguards methods	1	2	57 921	-	57 921
Studies involving reactors	3	1	41 126	-	41 126
Application of radioisotopes in agriculture	15	15	77 014	57 800	134 814
Application of radioisotopes in hydrology	4	2	37 175	-	37 175
Application of radioisotopes in medicine	13	9	88 385	54 140	142 525
Total	56	58	658 817	111 940	770 757

C. Analysis by country of contracts awarded or renewed in 1963

Country	Number of contracts placed	Number of contracts renewed	Contribution from Regular Budget	Contribution from Operational Budget	Total
			$	$	$
Argentina	1	2	13 400	3 200	16 600
Australia	1	1	7 174	-	7 174
Austria	3	4	49 970	-	49 970
Belgium	2	3	28 500	1 700	30 200
Brazil	1	-	4 600	-	4 600
Burma	-	1	-	6 870	6 870
Ceylon	1	-	-	2 000	2 000
Chile	1	1	11 300	10 400	21 700
Colombia	-	1	2 000	-	2 000
Congo (Leopoldville)	2	-	17 290	-	17 290
Czechoslovak Socialist Republic	1	4	48 795	-	48 795
El Salvador	1	-	4 800	-	4 800
Finland	-	2	14 400	-	14 400
France	-	1	1 200	-	1 200
Germany, Federal Republic of	1	1	14 100	-	14 100
Greece	3	1	22 890	4 000	26 890
Hungary	-	2	8 850	-	8 850
India	-	2	25 746	-	25 746
Israel	-	4	41 085	-	41 085
Italy	1	1	10 600	-	10 600
Japan	6	2	46 336	-	46 336
Korea, Republic of	4	-	7 540	7 350	14 890
Lebanon	1	1	3 175	3 450	6 625
Mexico	1	1	3 800	7 850	11 650
Netherlands	1	2	20 100	-	20 100
Pakistan	-	2	-	10 790	10 790
Peru	1	-	4 950	-	4 950
Philippines	-	2	-	12 850	12 850
Poland	2	2	24 540	-	24 540
Portugal	1	-	9 760	-	9 760
Rhodesia	1	-	-	6 910	6 910
Romania	6	-	51 210	-	51 210
South Africa	3	-	17 400	-	17 400
Spain	-	2	14 960	2 480	17 440
Sweden	1	2	19 500	-	19 500
Switzerland	-	2	9 980	-	9 980
Thailand	2	1	5 500	8 260	13 760
Tunisia	-	1	-	7 400	7 400
Turkey	1	-	-	9 780	9 780
United Arab Republic	-	2	6 850	4 150	11 000
United Kingdom of Great Britain and Northern Ireland	-	2	4 450	-	4 450
United States of America	1	1	39 401	-	39 401
Viet-Nam	1	-	-	2 500	2 500
Yugoslavia	4	2	42 665	-	42 665
Total	56	58	658 817	111 940	770 757