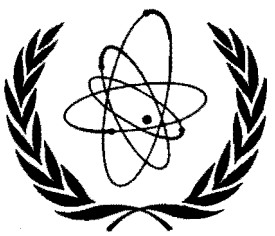
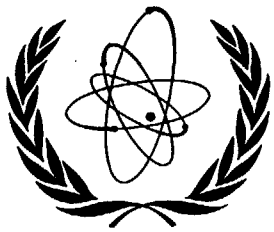


International Atomic Energy Agency

ANNUAL REPORT TO THE ECONOMIC AND SOCIAL COUNCIL OF THE UNITED NATIONS FOR 1964-65



International Atomic Energy Agency

ANNUAL REPORT TO THE ECONOMIC AND SOCIAL COUNCIL OF THE UNITED NATIONS FOR 1964-65

INFCIRC/61

Printed by the
International Atomic Energy Agency
in Austria - May 1965

THE AGENCY'S ANNUAL REPORT TO THE ECONOMIC AND SOCIAL COUNCIL OF THE UNITED NATIONS FOR 1964-65

The text of the Agency's annual report to the Economic and Social Council of the United Nations for 1964-65 is reproduced in this document for the information of all Members.

ANNUAL REPORT BY THE INTERNATIONAL ATOMIC ENERGY AGENCY TO THE ECONOMIC AND SOCIAL COUNCIL FOR 1964-65

(For the period 1 April 1964 - 31 March 1965)

CONTENTS

ANNEXES

List of Abbreviations

Agency	International Atomic Energy Agency
Board	Board of Governors of the International Atomic Energy Agency
BTU	British thermal unit
ECOSOC	Economic and Social Council of the United Nations
EPTA	United Nations Expanded Programme of Technical Assistance
FAO	Food and Agriculture Organization of the United Nations
IAEA	International Atomic Energy Agency
ILO	International Labour Organisation or International Labour Office
IMCO	Inter-Governmental Maritime Consultative Organization
MW(e)	Megawatt (electrical)
MW(t)	Megawatt (thermal)
UNCSAT	United Nations Conference on the Application of Science and Technology
UNESCO	United Nations Educational, Scientific and Cultural Organization
USAEC	United States Atomic Energy Commission
WHO	World Health Organization

NOTE

All sums of money are expressed in United States dollars.

INTRODUCTION

1. In the Agency's report to the General Assembly of the United Nations for 1963-64 [1] information is given on all the main activities of the Agency during that period.

2. The present report of the Agency to ECOSOC, therefore, concentrates on three subjects which, in the light of its discussions in recent years, would appear to be of particular interest to it, namely:

(i) Application of science and technology to development;

(ii) Trends in the Agency's technical assistance and training programmes; and

(iii) Co-ordination with other organizations.

3. As this report describes activities carried on during the period 1 April 1964 to 31 March 1965, ECOSOC may also be interested to note the level of the Agency's budgets during the two financial years in question. In 1964 the Agency's Regular Budget amounted to $7 444 500; the Regular Budget for 1965 has been set at $7 938 000. The Agency's Operational Budget, which is financed out of voluntary contributions, amounted to $2 367 500 in 1964 and has been set at $2 468 000 for 1965.

---

[1] United Nations document A/5792 - Agency documents GC(VIII)/270, Corr.1 and addenda and INFCIRC/59.

I. APPLICATION OF SCIENCE AND TECHNOLOGY TO DEVELOPMENT

4. This part of the report deals with the Agency's work in promoting the application of science and technology to development as requested by the Council in Resolution 1047 (XXXVII).

5. The following six topics have been selected by the Agency for consideration by the Advisory Committee on the Application of Science and Technology to Development as being of particular importance to the developing countries:

1. The development of nuclear power for electricity production;
2. The use of nuclear energy for desalting water;
3. The use of nuclear techniques to develop water resources;
4. The use of radiation to increase the storage life of food; [2]
5. The use of radiation to control or eliminate insect pests (with specific reference to the tsetse fly); [2] and
6. The use of radioisotope techniques in research in tropical and endemic diseases. [3]

6. In Annex I to this report the material is reproduced that the Agency has sent to the Advisory Committee on each of these topics and details are given, in accordance with the Advisory Committee's request, of new scientific knowledge available, promising lines of uncompleted research, the extent of the application of new knowledge available in developing countries, and the work being carried out by the Agency.

7. Topics 4 and 5 are considered by the Agency to meet the following criteria set by the Advisory Committee:

"(a) A solution would offer unusually great benefits by application in developing countries;

(b) The state of science and technology is such that a break-through may be realized if a massive, world-wide attack on the problem is made." [4]

These criteria may also well apply to the third topic.

8. The first two topics relate to two of the most important activities of the Agency and are of great scope and potential benefit to the developing countries, but the resources that their development or adaptation entail are of an order of magnitude considerably larger than that which the Advisory Committee appeared to contemplate in setting the criteria described above.

9. It will be realized that these six topics represent an important part but by no means all of the work the Agency is doing to promote nuclear energy to meet the needs of developing countries. The following are some of the other programmes that the Agency has continued or begun in the past year.

---

[2] The work on this topic falls within the scope of the Joint FAO/IAEA Division of Atomic Energy in Agriculture.

[3] This work involves co-operation between the Agency and WHO.

[4] United Nations document E/3866, para. 76.

1. Research reactors

10. The Agency encourages regional co-operation between research reactor establishments as well as "sister laboratory" arrangements between such establishments in technically advanced and developing countries. Regional meetings to discuss and co-ordinate research reactor programmes were held in Bucharest and Bombay, and a regional research reactor project, for which a crystal spectrometer was provided by India, has begun at Manila.

2. Radiation protection

11. Sufficient practical experience has been acquired with the Agency's standards for health, safety and waste management to begin revising some of the earlier work such as the Agency's Regulations for the Safe Transport of Radioactive Materials [5]. The "commercialization", as it has been called, of nuclear energy and its spread in the developing countries, renders it necessary for the Agency to develop direct assistance in meeting individual practical problems. The Agency has, for example, helped the Netherlands to make a safety assessment of the KSTR reactor at Arnheim, and is giving advice in reactor siting and safety to the Philippines under the Agency/Special Fund project in Luzon and to Tunisia in connection with a projected dual-purpose power reactor/desalting plant. The Agency is, in addition, setting up an advisory service on safety problems, and has sought the co-operation of ILO, FAO and WHO in this. The transport of irradiated nuclear fuel from reactor centres in various parts of the world to reprocessing plants in the technically advanced countries is also posing serious practical difficulties because of the novel questions they raise for ship owners and harbour and canal authorities. The Agency has accordingly set up a special evaluation service to help expedite such shipments.

3. Applications of radioisotopes

(a) Medicine

12. Research on medical applications of radioisotopes and their use in diagnosis and therapy continues to be one of the Agency's main programmes. In addition to the activities described under topic 6 in Annex I, there have been the following developments:

(i) Besides the customary technical assistance and research work on the physics of radiotherapy, the Agency has appointed an inter-regional adviser on hospital physics who is working in the Middle East, and a second adviser will be appointed in South East Asia, in consultation with WHO;

(ii) The Agency is now providing radiation data for medical use; and

(iii) The Agency has made plans for a new international dosimetry service which will begin later in 1965.

(b) Agriculture

13. Two of the activities of the Joint FAO/IAEA Division of Atomic Energy in Agriculture are described under topics 4 and 5 in Annex I. Other activities of interest to the developing countries include:

(i) A new co-ordinated research programme in Asia designed to develop better varieties of rice plant by experiments with radiation-induced mutations;

---

[5] Safety Series No. 6 - Agency publication STI/PUB/40.

(ii) The continuation of an earlier co-ordinated research programme to determine the best methods of using nitrogen and phosphate fertilizers in rice-growing areas of the world [6] and a similar new programme for improved maize cultivation in which institutes in Latin America and Romania are participating; and

(iii) A new programme to use radioisotopes in studying animal metabolism, animal diseases and the effect of environment on different animals.

4. Industry and the physical sciences

14. The Agency has continued to collect and publish information on the large savings that have been made by the application of radioisotopes and radiation techniques in industry, and on the savings that could be achieved if these techniques were applied more widely in the developing as well as the technically advanced countries. In 1965 the Agency is starting an advisory service to developing countries with a view to helping them introduce such techniques in individual industries and industrial processes.

5. Research contracts and laboratory work

15. During 1964 the Agency awarded some 130 research contracts, in the form of new contracts or renewals, to institutes for research in the various subjects described above and in support of certain other technical programmes. The Agency has contributed some $800 000 to this research and the institutes themselves have provided many times this amount. Besides this direct financial assistance, the Agency's Laboratory at Seibersdorf has been expanding its services in order to distribute radiation standards to scientific institutes, undertake various radiochemical analyses requested by Member States, to do supporting work for various Agency programmes, and to carry out other research work.

[6] See United Nations document E/3878 - Agency document INFCIRC/54 - para. 37.

II. TRENDS IN THE AGENCY'S TECHNICAL ASSISTANCE AND TRAINING PROGRAMMES

16. Requests to the Agency for all forms of technical assistance have continued to increase during the past year. Although it will be noted that the total resources available (including EPTA) to the Agency for technical assistance and training have increased from $1 647 204 in 1960 to $1 814 082 in 1964, they are still insufficient to meet a large proportion of the requests received by the Agency.

17. The main sources of finance of these programmes are the Agency's General Fund, which consists of voluntary contributions by Member States, and EPTA. The target set by the Agency's General Conference for voluntary contributions to the General Fund in 1964 and 1965 was two million dollars for each year, but at the end of March 1965 only $1 104 656 had been received for 1964 and $99 944 for 1965. A list of voluntary contributions by Member States to the General Fund for 1964 and 1965 is given in Annex II. The decreases between 1963 and 1964 and now apparent between 1964 and 1965 are particularly serious and increase the Agency's reliance on EPTA. Details of funds budgeted and funds available from voluntary contributions during the years 1960-64 are given in the following table.

Agency funds for technical assistance

Item	1960 $	1961 $	1962 $	1963 $	1964 $
Target set for voluntary contributions to the General Fund	1 500 000	1 800 000	2 000 000	2 000 000	2 000 000
Amount pledged	996 103	1 261 570	1 380 470	1 405 394	1 184 169
Amount budgeted for technical assistance	1 367 000	1 361 000	1 625 000	1 799 000	1 680 000
Funds available for technical assistance	1 007 842	980 881	1 146 294	1 209 173	1 062 700

18. Member States have continued to make contributions in kind and donations of equipment to further the purposes of the Agency in addition to the voluntary contributions to the General Fund referred to in paragraph 17 above. Details of the equipment offered and donated as contributions in kind during the reporting period are given in Annex III.

19. Requests made to the Agency in 1964 reflect the growth and diversification of the nuclear energy programmes of many of the developing Member States during the first part of the current decade. For example, in the first few years after the creation of the Agency in 1957, a large proportion of the requests were for assistance in establishing atomic energy programmes or in the more general elements of radiation safety. Now more Member States are seeking specialized assistance in the use of radioisotopes to solve various problems in agriculture, including the development of water resources, and in medicine and industry. As a result of the installation and operation of a large number of research reactors in developing countries, more requests are already being made for assistance in reactor programming, reactor physics, radiochemistry, radioisotope production and irradiation techniques. The volume of these requests is expected to grow in the future.

20. The Agency provided further training in 1964 for students by the different means at its disposal. It awarded 343 fellowships, financed assignments of 107 experts and visiting professors as advisers and lecturers in Member States, and held nine international or regional training courses. (This compares with 295, 83 and six respectively in 1963.)

21. Among other developments of interest to the Council were:

(i) The establishment of an International Centre for Theoretical Physics at Trieste [7] at which an Advanced School of Physics and a Seminar on Plasma Physics have so far been organized;

(ii) The holding of two training courses at the Middle Eastern Regional Radioisotope Centre for the Arab Countries in Cairo [8];

(iii) The training of eighteen students in the Agency's laboratories.

22. In addition, the Agency had become Executing Agency for three Special Fund projects by the end of March 1965: in Yugoslavia, the Philippines and Central America.

---

[7] See United Nations document E/3878 - Agency document INFCIRC/54 - para. 64.

[8] Ibid., para. 63.

III. CO-ORDINATION WITH OTHER ORGANIZATIONS

23. As the Council is aware, arrangements have been made to intensify co-operation between the United Nations in energy and power matters.[9] The major project of joint concern in 1964 was the Third International Conference on the Peaceful Uses of Atomic Energy which was held in Geneva from 31 August to 9 September. While the Conference, like its predecessors held in 1955 and 1958, was organized by the United Nations, responsibility for its scientific and technical aspects was entrusted to the Agency. As the Agency was able to provide most of the scientific secretariat as well as various other supporting services, the total cost of the Conference to the United Nations was substantially reduced.

24. Last year the Council was informed that the Agency had seconded a power economist from its staff to the Resources and Transport Division of the United Nations in order to promote more effective co-operation in energy and power matters.[10] Following the adoption of ECOSOC Resolution 1033 A (XXXVII), the secondment of the Agency staff member was extended until August 1965, and he is now also assisting in making arrangements for further co-operation between the two organizations in water desalination studies which could later involve the use of nuclear power.

25. As previously reported[11], technical liaison officers were exchanged between FAO and the Agency in April 1964 in preparation for the establishment of a Joint FAO/IAEA Division of Atomic Energy in Agriculture, which began operations at the Agency's Headquarters on 1 October 1964. The Joint Division is developing a single joint atomic energy programme on behalf of both organizations, and is ensuring that the technical services of both are brought fully into the joint operations. This joint programme is financed from the budgets of both organizations, from EPTA, the Special Fund, and from Trust Fund and other outside sources of support.

26. During 1964 the Directors General of WHO and the Agency appointed technical liaison officers to serve at Agency and WHO headquarters respectively. In December the Directors General met in Vienna, when they reviewed co-operation between the two organizations, in particular the technical liaison arrangements. It was agreed that these arrangements should continue and that the closest possible co-operation should exist to promote common approaches to problems of mutual interest and to avoid any undesirable duplication of effort, so that the two organizations can be of the greatest possible service to their Member States.

27. Arrangements were made for UNESCO to designate a member of the Scientific Council of the International Centre for Theoretical Physics which was established in Trieste on 1 July 1964 by agreement between the Agency and the Government of Italy. UNESCO is contributing to the cost of fellowships, the secondment of professors and the organization of the Advanced School of Physics, which is being held jointly by the Agency, UNESCO and the Italian National Institute of Nuclear Physics at the Centre.[12]

28. Following the adoption of Resolution GC(VIII)/RES/182 by the Agency's General Conference, discussions have been held between the Agency and UNESCO regarding ways of overcoming the serious lack in the developing countries of scientific and technical personnel, particularly specialists in atomic energy. The Agency is also participating in the International Hydrological Decade which is being promoted under the auspices of UNESCO.

---

[9] See topic 1 in Annex I and United Nations document E/3886, paras. 118 to 122.

[10] See United Nations document E/3878 - Agency document INFCIRC/54 - para. 70.

[11] Ibid., para. 68.

[12] See also para. 21 above.

29. Co-operation between the Agency and ILO included preparations for a panel of experts in 1965 to draw up a manual on safety aspects of mining and milling nuclear materials. This manual is being prepared as a result of discussions at a symposium on the subject which had been held jointly by the Agency, ILO and WHO in August 1963.[13]

30. Discussions were also held between representatives of IMCO and the Agency in December 1964 to review ways of future co-operation between the two organizations in questions concerning nuclear-propelled merchant ships.

[13] See also United Nations document E/3878 - Agency document INFCIRC/54 - para. 21.

ANNEX I

THE SIX TOPICS SUBMITTED BY THE AGENCY TO THE ADVISORY COMMITTEE ON THE APPLICATION OF SCIENCE AND TECHNOLOGY TO DEVELOPMENT AS BEING OF IMPORTANCE TO THE DEVELOPING COUNTRIES

1. The development of nuclear power for electricity production

(a) Description of activities

1. The technical and economic maturity of nuclear power became fully evident in the course of the Third International Conference on the Peaceful Uses of Atomic Energy (Geneva, 31 August - 9 September 1964), which reviewed the latest technological and cost developments. The three main proven reactor types - natural-uranium gas-cooled graphite-moderated, natural-uranium heavy water cooled and moderated, enriched-uranium light water cooled and moderated - have exhibited a better safety and availability record than conventional stations and their capital and fuel costs have been drastically reduced. As a result, units of 500 MW(e) and more can be considered competitive in areas where conventional fuel costs range between 25-30 cents/million BTU (e.g. coal at $7 to $9 a ton, fuel oil at $10 to $12) [1] with reasonable fixed capital charge rates (9 to 14%), while stations in the 300-500 MW(e) range may be competitive in 30-35 cents/million BTU region (e.g. coal at $9 to $11 a ton, fuel oil at $12 to $14), and 150-300 MW(e) reactors could compete in 35-40 cents/million BTU conventional fuel cost zones (e.g. coal at $11 to $13, fuel oil at $14 to $16).

2. It goes without saying that these figures can only be construed as general guidelines and that each specific case must be investigated with all its special features, but it is worth pointing out that the savings which can be achieved by the best selection of power equipment can be very large. For instance, if nuclear power produced by a 500 MW(e) reactor is competitive with power from conventional fuels at 30 cents/million BTU and is installed in an area where these fuels cost 35 cents, the resulting fuel saving over the reactor life may amount to two million dollars per year and add up over the life of the station to a total discounted value equal to one third to one half of the total capital cost of the reactor. Even in smaller sizes, nuclear energy units may present economic advantages over other sources of energy, for example, by reducing dependence on imported fuel in some cases, and through broad effects on the economy of the country concerned (reduced pollution, stimulus to scientific development, etc.).

3. It is not surprising therefore that the rate of construction of nuclear power stations envisaged for the next decades is sharply accelerating. Their capacity has increased from 5 MW(e) in 1955 to 5000 MW(e) by 1964, and there are firm commitments to increase it to 20 000 MW(e) by 1970. Between 1970 and 1980, 18-20% of new electrical capacity will be nuclear, and reliable opinions were expressed that in some large industrial countries more than half of their electricity needs will be provided by nuclear electricity by the turn of the century. Developing countries are also entering the field, although local conditions such as size of systems and foreign exchange problems call for very careful analysis in determining nuclear power competitiveness. A large programme is under way in India, while Pakistan has embarked upon, and the United Arab Republic, the Philippines and some other countries are actively considering the installation of nuclear stations.

---

[1] These and other price/weight equivalents are illustrative: there are considerable variations from these norms depending upon the quality of coal, etc.

4. The very prospect of rapid growth of nuclear power has led to concern for a better utilization of nuclear fuel resources, since present reactors utilize only a small fraction of the energy contained in the fertile and fissile materials which they use, and since their rapid expansion would, in the long run, be likely to strain the present resources of these materials. There is, therefore, a consensus that the ultimate objective of a nuclear economy (that is, the best use of nuclear fuels) remains the development of breeder reactors producing more fissile material than they consume. Not only would these reactors improve the utilization of the world resources of fertile and fissile material by more than an order of magnitude, but they would, at the same time, lower the relative importance of the fresh fuel cost component in total generating costs and thus make economic the mining of very low-grade uranium ores, bringing about possibly a hundred-fold increase in world nuclear energy supplies. It is particularly gratifying, in this connection, to note that the experimental breeder reactors in several of the reporting countries have operated satisfactorily and that the question of using breeder reactors on an industrial scale is essentially one of timing, estimated target dates ranging from the middle '70s to the middle '80s.

(b) The Agency's work

5. In a field marked by such rapid development as that of nuclear power, it is essential for developing countries to keep abreast of the latest technical developments, to evaluate them and to apply them to their specific position. The Agency's activities are designed to assist them in achieving these objectives by providing:

(a) Reviews of the technical and economic status of nuclear power through:

(i) Major conferences, such as the 1964 International Conference on the Peaceful Uses of Atomic Energy; [2]

(ii) Specialized scientific meetings on subjects of particular importance and interest followed by comprehensive reports, as, for instance, a panel to be held in June 1965 on the utilization of thorium in power reactors which, considering the large thorium resources of several developing countries, might prove of particular interest to them; and

(iii) Annual reports to the General Conference;

(b) General studies on the evaluation of the costs and economics of nuclear power. The Agency has completed a study on the methods of estimating nuclear power generating costs. It is about to publish a review of the economic aspects of integrating nuclear power stations in electric power systems and intends to carry out a study on the special problem of costing nuclear power in developing countries; and

(c) Assistance to Member States in surveying their present needs and assessing the possibilities of nuclear power in meeting these needs. This assistance is tailored to the requirements of the requesting countries. General surveys have been made in Finland, El Salvador, the Republic of Korea, Pakistan, the Philippines and Thailand. In the case of Pakistan, the general survey was followed by specific assistance in assessing the bids for construction of a reactor in East Pakistan; while in the Philippines a Special Fund Preinvestment Study is now being carried out to determine the most economic pattern of electric power expansion over the next ten years, and the role of nuclear stations in this pattern.

---

[2] See also part III, para. 23.

2. The use of nuclear energy for desalting sea water

(a) Description of activities

6. A nuclear reactor can be used to produce the energy (heat or electric power) needed to operate a desalting process. A distinction must be drawn between progress in the technology of desalting and progress in the technology of the various types of energy sources that may be used to operate the desalting process.

7. With regard to desalting, work is progressing on a number of different techniques for converting sea or brackish water into fresh water (most advanced processes are distillation processes including flash evaporation, vapour compression and long tubes vertical systems, electrodialysis, freezing). Over 30 desalting plants are at present operating or under construction, ranging in capacity from 250 000 to nearly seven million gallons/day. Nearly all are located in arid areas or on islands. The most common processes use heat directly, mostly by flash distillation which is at present the most developed technique. Present techniques make it possible to produce water at less than one dollar per thousand gallons [3]. This figure is much too high for the purpose of agriculture, which is supposed to be less than ten cents per thousand gallons, but is cheap enough for many municipal and industrial uses. It is anticipated that during the next decade the cost of desalted water could be brought down to half or a third of the present price, permitting certain types of agriculture (i.e. cultivation of vegetables). Such a result would be obtained by improving the desalting techniques, by scaling up the sizes of desalting plants and by using cheaper energy (i.e. from large nuclear reactors).

8. Nuclear energy is not currently used for desalting. Extensive studies, however, have shown that there are favourable prospects for such use in large size nuclear plants. This is especially true for dual-purpose installations producing power and water simultaneously, where, in some cases, a high load factor can be achieved for the reactor through flexibility in the output of the two products.

9. Most of the present desalting plants have been constructed in the last ten years and progress in desalting technology is likely to be rapid, regardless of the source of energy. Since the cost of energy, whether thermal or electric, represents a major component of the fresh water cost, the use of nuclear energy for desalting is particularly dependent on the progress achieved in nuclear costs, which have been summarized under topic 1 above and for which the latest data are extremely encouraging.

10. The table shows some recent estimates of costs of water and electricity from large dual-purpose stations using power reactors (with fixed charges of 7% and a load factor of 80%) [4]:

Power	Water production and cost	Electricity production and cost
3220 MW(t)	350 million gallons per day at 31 cents per thousand gallons	390 MW(e) 0.36 cents/kWh
8300 MW(t)	620 million gallons per day at 23 cents per thousand gallons	1410 MW(e) 0.24 cents/kWh

[3] Provided the output is of the order of one million gallons per day or more.

[4] An assessment of large nuclear powered sea water distillation plants (March 1964) (USAEC).

These are preliminary studies only, and no such installations are likely to be in operation before the next decade. The power output alone of these installations would be much too high when compared with the total national demand of many developing countries.

11. It will be clear from the foregoing that at present nuclear energy can only be considered when the demand for fresh water for domestic and industrial consumption or the combined demand for fresh water for these purposes and electricity justifies a large plant. In other words, it can only be considered for a reasonably large urban or industrial complex.

12. The main need is to proceed from theoretical studies to demonstration installations, especially of dual-purpose nuclear plants. Only on this basis will firm cost figures become available. A useful demonstration project would be of the order of 300 MW(t) costing around 25 x $10^6$$. It is likely that one such plant will be constructed during the next few years.

13. The question of further reducing the cost of the nuclear energy component in the desalting process is dealt with under topic 1.

14. The potential importance of fresh water for the developing countries is inestimable. About 60% of the earth's land surface is classified as "extremely arid, arid, or semi-arid", comprising very large developing areas. If these vast arid and semi-arid zones which at present support only 5% of the world's population, and that at a very low level, could be used, the problem of dealing with the world "population explosion" might be more easily manageable. [5]

(b) The Agency's work

15. The promise offered by new developments in desalting has attracted wide attention, including that of the major nuclear powers. On 18 November 1964 the Union of Soviet Socialist Republics and the United States of America concluded an agreement in Moscow on "Co-operation in the Field of Desalination including the Use of Atomic Energy". Paragraph VI of this agreement provides that "the Parties will give the IAEA copies of accounts, reports and other documents which they exchange and also, in appropriate cases, invite IAEA observers to symposia and scientific meetings held by the Parties". The two Governments jointly communicated this agreement to the Director General on 26 January 1965. It has been distributed to the Agency's Member States and to the Advisory Committee on the Application of Science and Technology to Development.

16. Since this application of nuclear energy is likely in time to be of particular interest to developing Member States the Agency is giving priority to it. It is holding a series of panels of experts from interested Member States which meet periodically to review the latest technological developments and the Agency's relevant activities. It has recently published a technical report [6] on the present status of desalting and the possible role of nuclear energy. It is prepared to support research and has given a research contract to an institute in Israel.

17. In connection with possible nuclear demonstration installations the Agency has made a survey of prospects for dual-purpose plants in Southern Tunisia. It is following closely the intensive work being undertaken, particularly in the United States of America; Agency observers are taking part in study groups convened by the Governments of the United States and Israel to examine various aspects of a projected nuclear desalting plant

---

[5] See also the United Nations report entitled Water Desalination in Developing Countries (ST/ECA/82).

[6] Desalination of Water Using Conventional and Nuclear Energy - Technical Report Series No. 24.

in Israel. The Agency has also been represented by an observer at discussions between experts from the United Arab Republic. Moreover, it maintains close contacts with the relevant services of the organizations in the United Nations family on these matters.

3. The use of nuclear techniques to develop water resources

(a) Description of activities

18. In evaluating and exploiting groundwater, the basic information required is volume, quality, accessibility, origin and destination. In all these respects radioisotope techniques provide useful and sometimes unique information. The major uses of isotope techniques are:

(a) Measuring the velocity and direction of groundwater flow by injecting short-lived radioisotopes into a single borehole;

(b) Tracing of groundwater interconnections by using natural and artificial radioisotope tracers; and

(c) Determining areas of recharge and measurement of recharge by the above techniques complemented by measurement of the concentration of naturally occurring radioactive and stable isotopes.

19. The use of radioisotopes injected into boreholes is being increasingly applied to the measurement of both the velocity and direction of groundwater flow. The technique is easy to apply and is economical in terms of personnel and equipment. The method is also being applied to detect and measure seepage through hydraulic structures, particularly dams.

20. Artificially injected radioisotopes are being used for establishing underground connections between different water bodies. So far such interconnections have been up to a few tens of kilometres.

21. Considerable potential exists in the application of environmental tritium and possibly also carbon-14 to the large scale study of a number of groundwater parameters. Measurement of the tritium content of samples taken from different parts of an aquifer have established groundwater flow rates, areas of recharge and rate of recharge. To avoid over-use or exhaustion, the rate of recharge must obviously be determined before rational groundwater development can proceed. The use of tritium is financially much more economical than the standard method of pumping tests.

22. There is a need for suitable groundwater tracers incorporating radioisotopes of a convenient half-life. Current research is aimed at developing compounds which do not suffer absorption during passage through different types of formations.

23. Owing to the 12.26-year half-life of tritium the age range is limited to about 50 years in groundwater studies. The use of carbon-14 would considerably extend this range. However, research is being carried out at present to determine the extent to which exchange takes place between the carbon-14 in solution and the carbonates in the rocks through which the groundwater passes. A knowledge of the degree of exchange is necessary to correct the age values determined by measuring the carbon-14 content of the water.

24. So far these techniques have mainly been carried out in the more advanced countries. However, there is a wide scope for their application, particularly in the developing countries, because many of these countries are in arid regions where development largely depends on judicious groundwater utilization. The reason for their not having more widespread use is the lack of knowledge of the possibilities of their application and the shortage of trained personnel and equipment.

(b) The Agency's work

25. The reports of two panel meetings [7] and the proceedings of a symposium [8] outline the possibilities and limitations of these techniques. At present the number and size of the groups engaged on research and development of these methods is rather limited. Therefore in an endeavour to achieve a more co-ordinated and collaborative approach the Agency has set up a series of working groups. At these meetings, the first of which took place in April 1964, a brief survey was given by each group of its present and future programme followed by a technical discussion. It is planned to hold such meetings once a year on an average and to rotate the place of the meeting amongst the various groups. Such meetings are not only very helpful to the participants but also in choosing the areas in which the Agency awards research contracts (of the value of $60 000 in 1964). In some cases the research work under these contracts is carried out in areas where the results are also of immediate practical importance, such as in a study of the groundwater flow in the Vienna basin and in the measurement of the flow rate of rivers in Rhodesia where conventional methods cannot be applied.

26. The Agency operates an advisory and experimental service in the application of isotope techniques to hydrological problems. An investigation was initiated and is currently in progress to study the groundwater system in the region of Lake Chala in Kenya. This project is concerned with the development of irrigation in the area. Like a number of applications in hydrology, it is not possible in this case to estimate the cost savings since no other known method can provide the same information.

27. Some of the projects in which the occurrence of natural tritium is applied to a study of hydrological problems require a longer period of investigation. For example, a detailed study of the occurrence of tritium, deuterium, oxygen-18 and some trace elements is being made in the Antalya region of southern Turkey in an attempt to provide information on the groundwater system in connection with the development of hydro-electric power and irrigation.

28. A smaller study within the framework of a Special Fund project in Jordan indicated either a slow movement of groundwater or considerable mixing with old stored water. However, a continuation of this project will enable more precise conclusions to be drawn.

29. Following the visit of an Agency advisory mission, the Agency is currently assisting Chile with the application of isotope techniques to a study of the leakage in a reservoir to be used for hydroelectric power.

30. Those investigations being made in the developing countries assist promotion of these new methods by providing training in the field. At the same time fellows are being trained in the Agency's Laboratory in the analytical techniques, and are also able to follow current projects executed by the Agency.

31. The emphasis has been placed here on the development of groundwater resources to which increased attention is now being directed at a time when the world's demand for water is rising very steeply. It should not be forgotten that isotope techniques can play a prominent role in other areas of hydrology. Their use in gauging the flow of rivers has already been touched upon and they are also being used for studying the siltation of harbours and waterways. Current research in the latter case is directed to the development of a quantitative method for the measurement of the bedload of rivers, which is a very important factor in the construction of dams and reservoirs.

---

[7] Application of Isotope Techniques in Hydrology - Technical Report Series No. 11; Isotope Techniques for Hydrology - Technical Report Series No. 23.

[8] Radioisotopes in Hydrology - STI/PUB/71.

4. The use of radiation to increase the storage life of food [9]

(a) The uses of radiation

32. Radiation can be used:

(a) For food preservation, and also for destruction of pathogenic micro-organisms and parasites transmitted through food;

(i) By delaying microbial spoilage and delaying or inhibiting metabolic changes (ripening, sprouting, etc.); and

(ii) By destroying pathogenic organisms which cause food poisoning (e.g. Salmonella) or parasites (e.g. Trichinella, etc.); and

(b) For disinfestation by destroying insect pests in stored grain and other foods.

Application (a)(i) is generally used in conjunction with other conventional methods such as refrigeration but substantial progress is being made towards safe long-term preservation of highly perishable foods such as meat, fish, fruits and vegetables without refrigerated storage.

(b) Food preservation

33. Large-scale experiments in certain countries (Soviet Union, United Kingdom, United States) have shown that radiation can be safely used to delay spoilage of certain foodstuffs. Thus it has been found that the usually rather limited period of safe storage and marketing for such highly perishable commodities as fresh chicken, meat, fish and crustaceans can be significantly extended, with resulting marked benefit from both economic and dietary standpoints. Similar results are obtained with fresh fruits, and it has been estimated that in the case of one perishable crop in the United States, current losses of 25% could be reduced by three quarters. Sterilization of bacon for long-term storage in hermetically sealed containers has also been achieved by the use of radiation whereas this is not possible by other conventional methods of processing. Clearance has already been given for public sale of radiation treated foods (bacon, wheat and wheat products, and potatoes) in certain countries, and applications for clearance are pending for a broad range of others (fruit, vegetables and marine products).

34. The related application of preventing the sprouting of potatoes is now being used on a semi-commercial scale in some technically advanced countries. For example, a full-scale commercial plant for the irradiation of potatoes is under construction in Canada.

35. With regard to food preservation, the pilot plant rather than the research stage has been reached in many applications. However, more research is needed on the process of microbiological spoilage and metabolic changes, for instance in fruits and vegetables.

(c) Disinfestation

36. Laboratory studies in the Soviet Union, the United Kingdom and the United States have demonstrated the unique biological efficiency of irradiation as a means of destroying insect pests in stored food. For the treatment of packaged foods, such as dried fruit, no other treatment method is known that will kill insects at all stages within the intact package without in any way affecting the contents or the package itself.

---

[9] Also proposed as possible "breakthrough" topic.

37. With regard to disinfestation, the time is ripe to proceed from the laboratory through the pilot plant stage to commercial operation. This can be done by developing operational data and economic information from pilot scale studies under commercial operating conditions.

(d) Extent of application in the developing countries

38. Some of these new techniques have now reached the stage of commercial development in the advanced countries and offer great promise for the developing countries, especially in tropical areas where refrigeration is difficult, spoilage is rapid and insect pests are particularly rife.

39. The obstacles to application are general lack of knowledge of initial preparation and packaging techniques and shortage of specialist personnel and equipment. Radiation sources themselves are becoming more easily and cheaply available in developing as well as advanced countries. Radiation can only be used for disinfestation when the grain is handled in bulk.

40. Electron machines are becoming more efficient and more reliable. With adequate international support of research on potential applications and local problems of food processing and irradiation in the developing countries and the establishment of regional research centres where needed, within the framework of appropriately comprehensive programmes for the over-all development of general food processing, preservation and distribution facilities, very substantial contributions to available food supplies and to improved standards of nutrition could be achieved.

41. The cost of pilot or commercial prototype plants for both food preservation and disinfestation is of the order of $200 000 to $600 000. The capital cost of full-scale plants for handling various quantities of food is estimated as follows:

Food	Commercial Co^{60} radiation plants for Capacity	Cost in US $
Fish preservation	1 ton per hour	250 000
Fruit preservation	10 tons per hour	1 000 000
Salmonella control	1.5 tons per hour	700 000
Grain disinfestation	70 tons per hour	400 000

(e) The joint work of the Agency and FAO

42. The Agency and FAO have held a number of scientific meetings to promote practical application of atomic energy to food preservation. These have included a meeting in 1960 on the Microbiology of Irradiated Food and expert panels in 1962 on Radiation Disinfestation of Grain and on Radiation Control of Salmonella in Food and Food Products, and in 1964 on the Application of Food Irradiation in Developing Countries. The latter panel recommended the establishment of food irradiation research centres in certain developing areas where investigations could be undertaken on an international basis, by local specialists in food technology with the co-operation of radiation specialists from developed countries, on urgent problems that show promise of solution by the use of ionizing radiations. Another general recommendation emphasized the importance of organizing training in food irradiation for scientists in the developing countries in order to provide technical staff to carry out research and practical experiments. Practical recommendations were also formulated on a number of research topics, including preservation of

fish and marine products, the disinfestation of dried and smoked fish, and the preservation and disinfestation of fruits and vegetables and their products (e.g. dried fruits).

43. The advancement of such possibilities has been facilitated by evidence on nutritional adequacy and wholesomeness of irradiated foods presented at a joint FAO/WHO/IAEA meeting held in Brussels in 1961 and more recently in Rome in 1964, when recommendations were made with respect to a common international approach to legislative control of the production and use of irradiated food.

44. Research on food preservation is receiving direct financial support from the Agency and FAO, through the joint division in Vienna, by the granting and co-ordination of research contracts at scientific laboratories in various countries (at present seven contracts to the value of some $40 000 a year). The results of these investigations on certain basic microbiological and biochemical problems of food irradiation are made available to other scientists through periodic co-ordination meetings and will eventually be published. At present main emphasis is given to investigations on means of reducing the radiation dose required to attain necessary microbiological objectives.

45. Within the framework of a tripartite agreement with the Österreichische Studiengesellschaft für Atomenergie (Austrian Atomic Energy Society) and the European Nuclear Energy Agency, the Agency supports research on radiation preservation of fruits and fruit juices carried out at the Austrian Reactor Centre.

46. Practical realization of some of the new food preservation procedures is being supported by the Agency and FAO through fellowships and through technical assistance (India) and expert advice. The latter is provided mainly in the form of missions sent to various countries to explore the possibility of setting up pilot plants in order to evaluate the economics of grain disinfestation on a realistic basis (Pakistan, January 1963; Turkey, March 1964; Argentina, October 1964). Advice on special food preservation problems is also being given to certain African and Asian countries.

47. Continued support in these areas is required to capitalize on the momentum of the work and the interest that is being generated in these countries. The development of cadres of knowledgeable and trained personnel is essential to these countries becoming self-sufficient and able to solve many of their own problems. One of the most convincing methods is through demonstration pilot plants where local personnel can be trained to operate the equipment and can gain experience in overcoming problems during actual operational conditions.

5. The use of radiation to control or eliminate insect pests (with special reference to the tsetse fly)

(a) Description of activities

48. Radiation is used to induce sterility in artificially cultured male insects which, when released into a wild population at a high ratio at the right point on the population cycle of the species, cause it to die out because the wild females mate with the sterile males. This technique has unique advantages; it enlists an inherent instinct to bring about the destruction of a given species without molesting any other species in the environment and without leaving the harmful residues often associated with chemical insecticides.

49. The technique has been used successfully in the United States against the screw worm (the larva of this insect infests wounds of animals and navels of newborn animals), and to eliminate the oriental fruit fly and melon fly from islands in the Bonin and Mariana archipelagos, and also the cockchafer. It has been used experimentally with success against the house fly, Mediterranean fruit fly and Queensland fruit fly. It is most probable that the technique can be used against many other insect species (particularly in the order Diptera) that afflict domestic animals, crops and man.

50. The effectiveness of the technique must be investigated for each particular species. This involves studies of the dispersion and, in particular, of the population cycle and mating habits and the devising of means for the artificial culture and sterilization of the male insects.

51. The technique is new, even in technically advanced countries, and the usual problems of shortage of skilled personnel and facilities apply. Insect pests and the human and animal diseases (as well as the losses to crops and stored agricultural products) that they cause, are today a far greater problem in developing than in most advanced countries. A concerted attack is therefore particularly urgent. Once the problem of artificial rearing of a particular species is solved it is necessary to start pilot-scale eradication and ecological projects and then to pass on to full-scale operations.

52. As the report of the Advisory Committee on its first session [10] pointed out, the tsetse fly presents a particularly interesting target since it affects man in two ways - as the vector of sleeping sickness and as the enemy of his protein supply. It is a problem that affects developing countries only, and its incidence, though vast, is relatively well defined.

53. Various experts have estimated that when the number of insects in a given area is small the efficiency of the sterile male technique is high, and this method is more economical than the use of insecticides or other conventional methods. It has, for example, been estimated that the cost of eradicating the Mediterranean fruit fly by this method would be one third to one half of that of using insecticides, which costs about $11 to $12 per acre.

54. The combined use of insecticides and sterile insects is more efficient than either technique by itself where the insect population is high. It has been estimated that with such a combination the cost of eradicating the tsetse fly would be reduced from $600-800 to $175 per square mile.

(b) The Agency's work

55. Support is being given to two laboratories by the award of contracts for research on the sterile male technique for the eradication of the tsetse fly. This insect has a complicated reproductive cycle, a very low reproductive potential and a relatively long cycle of development. It is therefore desirable to extend the area of research, particularly with regard to the development of mass rearing and sterilization.

56. Other research contracts have been awarded by the Agency for work on the Mediterranean fruit fly (three), olive fly (two), oriental fruit fly (one), Queensland fruit fly (one), leopard moth (one), and pine moth (one). Special attention is being given to the Mediterranean fruit fly because it is widely found in developing countries and is the most destructive of the fruit flies. It is expected that the Agency will be the Executing Agency for a United Nations Special Fund large-scale demonstration project for the eradication of the Mediterranean fruit fly in selected areas in Central America. Particular attention is also being given to research on the olive fly because it causes great destruction in the Mediterranean countries. An Agency panel held in July 1964 recommended that research on the eradication of these species be increased.

57. The Agency also publishes information circulars and gives technical assistance and advice. The Agency's Laboratory at Seibersdorf is conducting research on insect mass rearing techniques; on methods of labelling insects with isotopes to measure their

---

[10] United Nations document E/3866.

population density and dispersion; and on the development by radiation and selection of insect strains, for eventual sterilization and release, that will be more sexually vigorous and have a higher environmental resistance than the normal variety of the species.

6. The use of radioisotope techniques in research in tropical and endemic diseases

(This section has been prepared by the International Atomic Energy Agency, and the World Health Organization has participated in the drafting.)

(a) Description

58. Radioisotopes can be used as tracers

(i) to study the etiology and epidemiology of a number of endemic diseases affecting a large number of people in the developing countries and, in particular, in tropical areas;

(ii) to study the effects of these diseases on individuals, and the efficiency of specific therapy.

(b) New advances in knowledge

59. The use of radioisotopes has greatly advanced our knowledge of such problems as the metabolism of a number of essential nutrients (iodine, iron, calcium, certain vitamins, etc.) and the life cycle of certain parasites. For example, the effects of lack of protein in the diet, or the impairment of proper food absorption brought about by intestinal infestation with certain worms, are now much better understood. Anaemia is extremely widespread and may be caused by dietary iron deficiency, increased blood loss, poor vitamin absorption, congenital abnormalities, or a combination of all these factors.

60. Campaigns against many tropical diseases (malaria, African trypanosomiasis, arthropod-borne virus diseases, etc.) are based on the knowledge of the ecology of insect vectors which can be elucidated by a technique using radioisotopes. Better understanding of the behaviour of arthropod vectors (dispersal range, seasonal movement), epidemiological studies, physiology of these vectors, etc., could benefit from the use of radioactive tracers.

61. Radioisotope techniques are well established in many branches of medical research and can make a valuable contribution to research in the tropical and endemic diseases which cause debilitation and death, thus affecting the labour force of millions of people, and thereby profoundly influencing the economy of the countries concerned.

62. Many small medical research projects are at present under way in countries with a tropical climate. An intensified effort in studying and controlling endemic diseases can make use of radioisotopes, which would eventually involve collaboration between laboratories in developed countries and institutes of developing countries. The fight against widespread diseases such as trypanosomiasis, schistosomiasis, filariasis and malaria has not yet fully benefited from the use of radioisotopes.

(c) Extent of application in developing countries and obstacles to such application

63. Although in most developing countries, hospital and medical facilities are among those institutions which have attained a relatively high level of practice in the use of radioisotopes, the introduction of advanced and very specialized techniques requires a corresponding effort in general supporting services, training of personnel, etc. Unfortunately, the infrastructure and social and political factors needed for the full development of research institutes do not always exist and the development of such an

infrastructure would require efforts which are beyond the means of the countries concerned. International assistance in this respect meets especially the difficulty of recruiting consultants for such radioisotope projects.

64. The obstacle of transporting radioisotopes over long distances is becoming less acute with the greater number of isotope-producing reactors being built in developing countries.

(d) The Agency's work

65. At the present time the Agency is directly supporting research on tropical diseases through more than 30 research contracts in force, involving an annual expenditure of approximately $150 000. A number of priority subjects for research were selected in 1962, namely: (i) anaemia; (ii) goitre; (iii) nutrition; and (iv) effects of parasitic infection. Under each research contract the Agency provides funds for expenses such as additional staff, equipment and expendable supplies and, whenever possible, advice on the spot by Agency experts. The results of this work are published in the general scientific literature. Each year, expert groups in each of the four subjects are convened to discuss the work undertaken by participating institutes.

66. The Agency also helps this work in other ways: at present ten technical assistance experts are in the field to advise on the use of isotopes in tropical diseases. It awards annually about 30 training fellowships and organizes one or two training courses per year for another 30 to 40 physicians and hospital physicists. The last course of this type was held from October to December 1964 in Manila, Philippines, for 20 students from ten countries in the Middle East, South-East Asia and the Far East. In 1965, a symposium will be held jointly with WHO on the use of radioisotopes in tropical medicine. The Medical Physics section of the Agency's Laboratory is at present doing work on radio-isotope measurement techniques, the results of which are expected to be of value in this work.

(e) WHO's work

67. WHO is concerned with the over-all planning and priorities for eradication of tropical and endemic diseases. The Organization is giving assistance to a large number of research projects in these fields and, in many of these activities, radioisotopes are employed as a routine tool. They are used in experimental studies of pathogenesis of disease, in genetic studies, in the study of the biology and metabolism of different parasites, in the studies of the mechanism of host/parasite relations, in studies of absorption and metabolism of iron and proteins, etc. It is difficult to single out projects in the many fields involved, which include bilharziasis, filariasis, onchocerciasis, trypanosomiasis, malaria, nutrition, etc.

68. WHO supports laboratory studies in the use of irradiation and radiomimetic chemosterilants being tested for the eradication of whole insect populations.

69. In nutrition studies, radioisotopes are used in WHO-assisted projects on hookworm infection in relation to iron deficiency anaemias, on the absorption and dermal losses of iron, on folic acid deficiency, on anaemia in pregnant women, and in several other studies of nutritional anaemias. They are also employed in a study of protein requirements in infants and children.

70. Fellowships have been awarded by WHO to familiarize scientists with isotope techniques. Isotope uses are reviewed, and the results of studies which employ them are considered along with other developments in research techniques, at the scientific meetings which form part of the Organization's programme.

ANNEX II

VOLUNTARY CONTRIBUTIONS BY MEMBER STATES TO THE AGENCY'S GENERAL FUND FOR 1964 AND 1965

Member	Contribution pledged (equivalent in United States dollars at Technical Assistance Board rates)		Paid $	Paid $
	1964	1965	1964	1965
Argentina	15 000	15 000	-	-
Australia	20 000	20 000	20 000	20 000
Austria	5 000	8 200	5 000	2 500
Belgium	10 000	-	10 000	-
Brazil	19 000	19 000	-	-
Burma	1 000	1 000	1 000	-
Canada	57 600	57 400	57 600	-
Ceylon	2 100	2 100	2 100	-
China	5 000	5 000	5 000	-
Congo, Democratic Republic of	333	2 000	-	-
Denmark	10 600	10 600	10 600	10 600
Ethiopia	-	1 000	-	-
Finland	6 800	6 800	6 800	-
France	30 612	30 000	30 612	-
Germany, Federal Republic of	105 200	104 800	105 200	52 400
Greece	4 200	4 200	4 200	-
Holy See	2 000	2 000	2 000	2 000
India	25 000	35 000	25 000	-
Indonesia	2 000	2 000	-	-
Iran	-	2 000	-	2 000
Iraq	-	1 600	-	-
Israel	2 800	2 800	2 800	-
Japan	40 000	40 000	40 000	-
Korea, Republic of	3 000	3 000	3 000	-
Lebanon	1 000	-	1 000	-
Liberia	6 301	-	-	-
Mexico	13 600	13 600	13 600	-
Monaco	2 000	2 000	2 000	-
Morocco	2 600	-	2 600	-
Netherlands	18 600	18 600	18 600	-
Norway	8 200	8 200	-	-
Pakistan	6 000	6 000	6 000	6 000
Philippines	4 000	4 000	4 000	-
Portugal	3 600	3 600	3 600	-
South Africa	9 800	9 800	9 800	-
Sweden	24 000	24 000	24 000	-
Switzerland	17 600	17 600	17 600	-
Thailand	3 000	3 000	3 000	-
Tunisia	1 000	-	1 000	-
Turkey	4 444	4 444	4 444	4 444

Member	Contribution pledged (equivalent in United States dollars at Technical Assistance Board rates)		Paid $	Paid $
	1964	1965	1964	1965
United Arab Republic	11 500	11 500	11 500	-
United Kingdom of Great Britain and Northern Ireland	144 000	140 000	144 000	-
United States of America	500 000	b/	500 000	-
Viet-Nam	-	2 449	-	-
Yugoslavia	7 000	7 000	7 000	-
	1 155 490	651 293	1 104 656	99 944
United States of America (matching contribution)	155 490 a/	532 876 b/	-	-
Total	1 310 980	1 184 169	1 104 656	99 944

a/ In addition to the voluntary contribution of $500 000, a matching contribution of dollar for dollar of the total contributions above $1 million, until a total of $1.5 million is reached.

b/ Total voluntary contribution equivalent to 45% of the total pledged by all Member States including the United States.

ANNEX III

CONTRIBUTIONS OF EQUIPMENT BY MEMBER STATES

A. Equipment offered as contributions in kind

1. The Council will recall that in 1962 the Governments of Bulgaria, the Byelorussian Soviet Socialist Republic, the Czechoslovak Socialist Republic, Hungary, Poland, Romania, the Ukrainian Soviet Socialist Republic and the Union of Soviet Socialist Republics had proposed that the Agency undertake a programme to establish six medical centres and six physics laboratories in the developing countries, one third of which being equipped by the said countries. In February 1964, the provision of one radiological centre by the Czechoslovak Socialist Republic to Algeria was arranged. In September 1964, the eight Governments in question, taking into account the requests received from Member States, replaced the offer of six physics centres by an equivalent offer (in terms of cost) of radiological centres in addition to the one for Algeria and stated their readiness to fulfil their share in the above-mentioned programme, irrespective of the participation of other States.

2. In January 1965, the Government of the Soviet Union informed the Agency that it was prepared to supply to developing Member States of the Agency equipment for two complete medical radiological centres in 1965 and two in 1966, together with experts and facilities for training; these centres would be set up in any four of the eight States that had previously submitted requests for such equipment.

3. The Governments of Hungary and Poland have announced that they will also each provide a radiological centre within the context of this programme. The Government of Bulgaria informed the Agency that it will contribute 20 000 roubles in the context of this programme.

B. Equipment donated as contributions in kind

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

Equipment donated to the Agency's Laboratory

Donor country	Equipment
Canada	14 000 curie cobalt-60 gamma cell
Federal Republic of Germany	X-ray fluorescence unit
France	Intertechnique two-parameter pulse height analyser and accessories
India	Six radiation survey meters, three contamination monitors
Japan	Analytical balance, Iwaki KM shaker
Netherlands	Low-level tritium counting system
Switzerland	Small precision type equipment: microbalances, electronic instruments, vacuum operator, etc.

Equipment donated for approved technical assistance projects in Member States

Donor country	Equipment
United States of America	1 isotope scanner 1 analyser computer 2 scintillation detectors 1 transformer 3 pulse analysers with pre-amplifiers and power sources 3 pulse height analysers 1 pulse generator 1 oscilloscope 2 medical radioisotope scanners, one with detector 1 scaler 1 power supply unit

The Government of the United States has also provided six new spectrometers to replace those in the Agency's two mobile radioisotope laboratories.