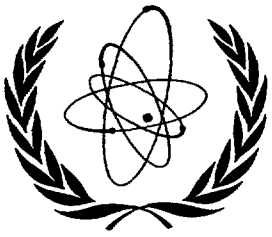

International Atomic Energy Agency

THE AGENCY'S PROGRAMME FOR 1965 - 66

GC(VIII)/275

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CONTENTS

LIST OF ABBREVIATIONS

ECOSOC	Economic and Social Council of the United Nations
ENEA	European Nuclear Energy Agency
FAO	Food and Agriculture Organization of the United Nations
IBWM	International Bureau of Weights and Measures
ICRP	International Commission on Radiological Protection
ICRU	International Commission on Radiological Units and Measurements
ICSU	International Council of Scientific Unions
ILO	International Labour Organisation
ISO	International Organization for Standardization
IUPAC	International Union of Pure and Applied Chemistry
OECD	Organisation for Economic Co-operation and Development
Third Geneva Conference	Third International Conference on the Peaceful Uses of Atomic Energy
UNESCO	United Nations Educational, Scientific and Cultural Organization
WHO	World Health Organization
WMO	World Meteorological Organization

NOTE

All sums of money are expressed in United States dollars.

I. INTRODUCTION

1. At its seventh regular session the General Conference requested the Board of Governors and the Director General to take steps to implement biennial programming within the framework of annual budgets, beginning in 1965 [1]. Accordingly, the Agency's programme of work for 1965 and 1966 has been prepared.

2. In the development of this programme, account has been taken of the experience gained over the six years of the Agency's existence which is also reflected in the long-term programme for the Agency's activities as endorsed by the General Conference during its seventh regular session [2].

3. Because there are borderline activities which may overlap with those of some of the specialized agencies - particularly FAO and WHO - the Director General has consulted other Directors General informally on certain aspects of the programme and has followed this up by formal consultations as required by ECOSOC Resolution 984 (XXXVI).

4. Under the provisions of the Statute, the Board can only submit to the General Conference annual budget estimates for the expenses of the Agency. However, the execution of the biennial programme described in this document is estimated to require finances totalling approximately $21.5 million under the combined Regular and Operational Budgets. Over the two years, an estimated $5.0 million will be provided from operational funds, and the balance from the Regular Budget. For the first year, the Board will submit estimates which amount to a little under fifty per cent of this sum.

5. In its elaboration of the programme the Board was conscious of the fact that the General Conference could not at this stage consider financial implications which go beyond 1965. Within budgetary limits approved by the General Conference, the Board and the Director General would need some flexibility in its execution. Particularly, if circumstances should make this necessary, the Board and the Director General should be able to bring activities now planned for 1966 forward for execution in 1965 and to defer others from 1965 to 1966.

6. The Board believes that the General Conference would not require to be informed of detailed programme plans for 1966 at its ninth regular session when it will be asked to approve the budget estimates for that year; the Board proposes at that time to report to the General Conference on the programme for 1965-66 only insofar as major modifications have occurred or are expected to occur or if new programme activities require attention.

7. The presentation of the biennial programme follows the form of annual programmes of previous years. A summary of the expenditure on the various parts of the programme for 1965 under the Regular and Operational Budgets is shown in the table below.

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[1] Resolution GC(VII)/RES/154.

[2] Resolution GC(VII)/RES/151.

Part of the Programme	Expenditure			
	1963 Actual	1964 Budget[a]	1965 Estimate[a]	Increase or (decrease) 1964:1965
	$	$	$	$
REGULAR BUDGET				
Technical assistance and training				
(a) Technical assistance	275 153	308 090	261 320	(46 770)
(b) Training	297 696	319 350	259 060	(60 290)
Nuclear power and reactors	507 319	582 300	606 100	23 800
Isotopes and radiation sources	617 386	663 220	797 890	134 670
Health, safety and waste management	960 767	1 043 710	925 600	(118 110)
Research and services in physical sciences	670 985	804 680	1 105 750	301 070
Safeguards	223 318	334 070	353 860	19 790
Information and technical services	905 108	1 001 610	1 102 450	100 840
Sub-total	4 457 732	5 057 030	5 412 030	355 000
OPERATIONAL BUDGET				
Technical assistance and training				
(a) Technical assistance	712 320	807 000	874 000	67 000
(b) Training	610 642	873 000	875 000	2 000
Isotopes and radiation sources	112 480	168 000	202 000	34 000
Health, safety and waste management	55 377	40 000	40 000	-
Research and services in physical sciences	225 329	479 500	477 000	(2 500)
Sub-total	1 716 148	2 367 500	2 468 000	100 500
TOTAL[b]	6 173 880	7 424 530	7 880 030	455 500

a/ For details, see Annexes II and III to document GC(VIII)/276.

b/ Excludes expenditures for the General Conference, the Board of Governors and General Direction and Administration.

II. TECHNICAL ASSISTANCE AND TRAINING

8. In order to produce the maximum benefit to the requesting country the Agency's long-term programme recognizes the need for all types of technical assistance to be combined as far as possible. In this connection the responsibility for all aspects of technical assistance falls under one department of the Secretariat; each country will be asked to submit its requests for experts, equipment, fellowships and training and research grants as one entity where multiple requests are involved. The Agency will then draw up a country programme of technical assistance to be financed from the Operational Budget.

(a) Technical assistance

9. The increase in need for assistance in the form of experts and equipment is reflected in the growing number of requests received from Member States. This increase is expected to continue in 1965 and 1966, mainly because Member States that received substantial bilateral assistance for the establishment of research reactors would seek multilateral aid after the reactors have reached criticality and a nucleus of laboratories has been established. Thus, exclusive of projects to be financed under EPTA, requests for assistance from the Agency rose from $690 000 in 1959 to $1 750 000 in 1963, and to

$2 650 000 for 1964. On the other hand, funds approved to meet these demands have increased from $620 000 in 1959 to only $807 000 in 1964, and of these sums usually no more than 70 per cent was actually available in past years. As a result, less than 30 per cent of the aid requested for 1964 will actually be provided.

10. The following table shows the increase in the requests for technical assistance since 1959 and the respective funds which could be approved within the annual target figures set by the General Conference.

Year	Value of projects	
	Requested $	Approved $
1959	690 000	619 400
1960	1 150 000	599 200
1961	1 277 600	513 100
1962	1 530 000	757 600
1963	1 750 000	856 700[a]
1964	2 650 000	807 000[b]
1965	2 900 000[c]	899 000[c]
1966	3 150 000[c]	1 187 000[c]

a/ 80% expected to be available.

b/ 70% expected to be available.

c/ Estimated.

11. For 1964, the Board has approved requests involving the services of 42 experts and equipment worth $345 000. In addition, technical assistance projects approved under EPTA provide in 1964 some 32 experts and equipment estimated at $73 000. The implementation of several projects initiated in 1964 will continue in 1965.

12. In 1965, it is expected that in addition to assistance which will be requested under EPTA, a large number of requests will be received for experts to be provided from the Agency's own resources, particularly in the application of radioisotopes, in agriculture, medicine and industry. It is estimated that next year the combined Agency/EPTA programmes will require approximately 760 man-months of technical assistance experts in various peaceful uses of nuclear energy; a conservative estimate at this time would indicate that of this total approximately one third may be provided under EPTA. In 1966, requirements are estimated at 790 man-months, of which 250 will be provided under EPTA.

13. With regard to equipment, requests exceeding $1.3 million were received for 1964 and only $345 000 could be approved. It is expected that in 1965 requests would continue to increase and the Agency may need about $450 000, of which approximately $100 000 can be expected to be available under EPTA. By 1966, the total is expected to rise to $480 000, with little or no increase in the funds made available under EPTA.

14. As in previous years, the Agency expects to be called upon to assist certain Member States in making arrangements to receive technical assistance directly from other Member States. It will also act as Executing Agency for two projects already approved under the Special Fund, and it may be required to assist in the preparation of further Special Fund projects, both in 1965 and 1966.

15. No further preliminary assistance missions are planned for 1965-66 but since the Agency cannot render effective assistance without being aware of changes in conditions in various countries, it will be necessary to dispatch similar but smaller missions; these will be concerned particularly with the evaluation of current projects and the consideration of possible further technical assistance, both under EPTA during the biennium 1967-68 and from the Agency's own resources in 1965 and 1966. It is therefore planned to send three such missions to various continents in 1965 and a similar number in 1966.

(b) Training

16. The shortage of specialists, trained personnel and educational facilities in the various aspects of nuclear power and in the application of radioisotopes remains one of the main problems in those Member States that endeavour to develop nuclear energy programmes or to introduce new techniques to improve public health, industrial development and agricultural yields. The assistance provided by the Agency will consist of awarding fellowships and research grants, placing visiting scientists, lecturers and professors in institutes in developing countries and organizing regional and international training courses, etc.

17. The table below shows annual requests for fellowships received by the Agency from 1958 to 1964.

Year	Nominations received	Awards granted[a/]
1958	287	161
1959	577	296
1960	649	385
1961	648	295
1962	588	384
1963	580	295
1964	492[b/]	193[b/]

a/ Types I, II and EPTA.

b/ Up to 30 June 1964.

Lack of funds has limited the award of fellowships to an average of 55 per cent of the candidates. About 45 per cent of the awards were financed from the Agency's own funds, and an average of 15 per cent of awards were Type II cost-free fellowships.

18. It is likely that the number eligible for awards in 1964 will still require funds which exceed the Agency's available resources, particularly in view of the steadily rising average cost of each fellowship. There are also indications that the number of Type II fellowships may decline, which will increase the relative demand upon the Agency's own funds. In addition, the training programme will have to meet annual obligations in respect of training at the Theoretical Physics Centre in Trieste, the NORA project and the Norway-Poland-Yugoslavia joint project.

19. As the fellowship programme under EPTA also tends to decline, it would appear that individual training may, in future, become more and more an integral part of other forms of technical assistance.

20. On the other hand, it must be expected that the demand for research grants, training courses and visiting professors will continue to increase.

21. Up to the end of 1963, 23 international and regional training courses were organized at which 435 trainees participated. During 1964, nine courses are planned, to be financed partly from EPTA and partly from Agency funds.

22. The Agency has already received more than 30 requests and suggestions for the organization of training courses during the period 1965-66. However, it is unlikely that available funds will permit the holding of more than ten such courses annually. During the biennial programme it is planned to cover, among others, the following subjects:

(i) Nuclear physics and radiochemistry;

(ii) Reactor technology and instrumentation;

(iii) Nuclear metallurgy;

(iv) Agricultural applications of radioisotopes;

(v) Medical applications of radioisotopes;

(vi) Industrial applications of radioisotopes;

(vii) Biological effects of radiations;

(viii) Radioisotope techniques in pest control;

(ix) Maintenance and repair of nuclear electronic equipment;

(x) Power reactors; and

(xi) Waste management.

23. The Agency will also continue to assist in establishing regional training centres, such as the Middle Eastern Regional Radioisotope Centre for the Arab Countries in Cairo. Thirty-five students had received training at the Centre up to the end of 1963.

24. By the same date, the Agency had assigned 97 visiting professors to developing countries, financed from Agency funds and under EPTA. It is expected, however, that the requests for 1965-66 will be approximately 40 professors annually:

Year	Visiting professors	
	Requested	Assigned[a/]
1959	8	8
1960	19	19
1961	23	18
1962	45	21
1963	43	31
1964[b/]	43	37

a/ Includes assignments from Agency funds and under EPTA and four professors provided cost free by Member States.

b/ Up to 30 June 1964.

Because of the shortage of funds, it will not be possible to meet all the requests. Where the subject of study and the training facilities permit the Agency will make every effort to co-ordinate the assignment of a visiting professor with the training of fellows from countries other than the country of his assignment.

25. The Agency's two mobile radioisotope laboratories have so far provided training for about 1400 students in the Far East, Latin America and Europe. They will continue to be used, particularly in countries in Africa where facilities for training in the general techniques of handling radioisotopes do not yet exist.

III. NUCLEAR POWER AND REACTORS

(a) Nuclear power

26. The Agency will play a predominant role in the Third International Conference on the Peaceful Uses of Atomic Energy which is being organized by the United Nations in Geneva. It is hoped that it will be possible for the Agency to publish an evaluation of the results of the Conference and to follow up any particular technical or economic conclusions that warrant further investigation. The Agency's biennial programme of conferences and symposia on nuclear power subjects will no doubt also be influenced by the results of the Third Geneva Conference.

27. Studies of the comparative economics of conventional and nuclear power will have to be continued over several years because the costs of conventional and nuclear power in different areas vary from year to year; these studies will also determine the advantage of introducing one or the other.

28. It is expected that Member States will continue to seek the Agency's assistance in studies on the prospects of nuclear power in their respective countries. During 1962 and 1963 such studies were carried out in Korea, Pakistan and the Philippines. In 1963, the Agency assisted Pakistan in preparing invitations for bids for a power reactor in East Pakistan and in 1964 a panel of experts will examine these bids and advise the Government thereon. In the Philippines, the study has led to a "Pre-investment Study on Power, including Nuclear Power, in Luzon" which is executed by the Agency for the United Nations Special Fund. To meet similar requests in the future, three nuclear power survey missions and one or two missions to assist reactor projects may be expected in 1965 and 1966.

29. As a sequel to the Agency's study on the economic aspects of integrating nuclear power plants in electric power systems, it is planned to continue in 1965, with the assistance of a panel of experts, the study of methods for estimating costs of nuclear power plants in one country on the basis of known or assumed costs in another country. The Third Geneva Conference is expected to reveal new data on the comparative costs of reactor systems in different areas.

30. The Agency has, in the past, published detailed reports on the experience gained in three Member States regarding the design, construction and operation of nuclear power plants. It is planned, in 1965 and 1966, to cover a wide range of reactors in more Member States, stressing important aspects of project design, construction, operating experience and costs.

(b) Reactors

31. Two further volumes of the "Directory of Nuclear Reactors" are expected to be published in 1965 and 1966; they will provide comprehensive information on the operational characteristics and design features of reactors newly put into operation or nearing completion. To supplement the Directory, it is hoped to publish also a simple index covering all reactors in the world, including basic information on projects under development.

32. A panel on the technical and economic aspects of the utilization of plutonium as a power reactor fuel [3] is expected to reveal a considerable amount of information on the technology and cost of processing, fabricating, handling and behaviour of plutonium in operating reactors. Since the production of plutonium in commercial power reactors has increased, it is considered appropriate to plan a second meeting on the subject in 1966.

33. During 1965 a panel will be organized to discuss how reactor types could be adapted to meet the requirements of a developing country.

34. The application of nuclear energy to saline water conversion is of great interest to many Member States. The Agency will continue design studies with emphasis on installations producing both electric power and fresh water, and research contracts will be granted to supplement available information. In March 1963, the Agency issued a status report on desalination; it is planned to review the situation every six months with the help of a panel of experts. Where appropriate, the Agency expects to be able to support installations intended for demonstration and international projects of this type. These efforts will be principally directed to obtain data on installations required by and feasible for developing countries. The interest of Canada, Israel, Mexico, Tunisia, the United Kingdom of Great Britain and Northern Ireland, and the United States of America in combined power and desalination plants justifies the Agency's continued work to examine other uses of nuclear energy for process heat.

(c) Reactor research

35. With regard to research reactor physics, the Agency will continue to promote and support international co-operation through such projects as NORA and its co-operative programme with Norway, Poland and Yugoslavia. Informal discussions indicate that other similar co-operative arrangements may develop in 1965 and 1966.

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[3] To be held in 1964.

36. The Agency's work on research reactor utilization will, to a great extent, be pursued on a regional basis; two or three study group meetings on specialized topics are planned for 1964 and 1965. It seems desirable, however, to maintain a certain flexibility in this kind of support by the Agency, so that, if necessary, it can be diverted to joint regional projects. For example, the Government of India has offered a crystal spectrometer to be installed at a research reactor in the Far East and preparations for a joint project involving the use of this instrument are proceeding. As part of the research reactor utilization programme it is planned to publish a manual on reactor experiments which may lead to an agreed code of practice for research reactor operation.

37. It is planned to hold meetings in 1965 and 1966 as a follow-up to the Symposium on Exponential and Critical Experiments held in September 1963 to discuss some of the newer techniques for obtaining information on reactor physics needed in the design of power reactors, e.g. pulsed neutron techniques, reactor noise analysis and spectrum measurement with detectors.

38. In the award of research contracts related to nuclear power preference will be given to:

(a) The effective utilization of existing research reactors in developing countries;

(b) Research related to the introduction of nuclear power into developing countries (for electricity, desalination or other process heat uses); and

(c) Fundamental studies in physics and chemistry involving the use of research reactors.

The Agency will, for example, give active assistance and advice on the design, procurement, installation and initial operation of in-pile radiation equipment including cryogenic equipment for work in solid state physics. A similar programme could be developed for simple but comprehensive equipment for activation analysis work at research reactors.

(d) Reactor safety

39. The Agency will continue to assist and advise Member States in the assessment of the safe design, operation, proper siting and containment of new reactors. Meetings are planned on the subject of containment to discuss hazard from reactors near large population centres. With regard to reactor safety the Agency plans to set up groups of experts - to be selected from a list of persons named by Member States - which can perform hazards evaluations of nuclear stations as well as of nuclear merchant ships in harbours and waterways.

(e) Nuclear fuels and equipment

40. In respect of nuclear fuels, the Agency will continue to assist Member States in securing information on different aspects of the production, treatment and utilization of source, special and other nuclear materials, nuclear metallurgy, radiochemistry, technology, fabrication of nuclear fuel elements and nuclear electronics. Requests for the transfer or supply of source and fissionable materials for reactor projects in Member States and for small quantities of special fissionable materials for research and calibration purposes will also continue to be dealt with.

41. It is planned to hold in 1965 a symposium on physical, radiochemical and metallurgical research using small quantities of fissile material. Such work is likely to be of great interest to developing countries that have small reactors and restricted radiochemical and metallurgical laboratory facilities.

42. If the second conference on nuclear electronics is held in 1964, a further conference on the same subject is planned for 1966. However, if, as is possible, the 1964 meeting has to be deferred to 1965, the next meeting on nuclear electronics will take place at a later date.

43. It is planned to hold in 1965 a panel on non-destructive testing and acceptance procedure for reactor pressure and containment vessels, to review different procedures in individual Member States where large pressure vessels are manufactured. If the results of these discussions so warrant, a symposium on non-destructive testing of components of nuclear reactor installations will be organized in 1966. The symposium will also consider other parts and components such as fuel elements, control rods and heat exchangers. The Agency, with the help of a panel of experts, may be able in 1966 to make recommendations also on the type of non-destructive testing to be applied in new nuclear power plants.

44. The following two panel meetings are also planned for 1965:

(a) To review different types of plutonium-beryllium and other neutron sources (accelerators) with the aim of arriving at recommendations on the development of different types of such sources for activation analysis, moisture determination, food irradiation and other research activities; and

(b) To review the use of low-energy (up to 5 MeV) high intensity particle accelerators for both electrons and ions and to arrive at recommendations on further development of these machines and their use in research in medicine and in industry as high intensity sources of X-rays, electrons and neutrons.

45. With the help of consultants, it is proposed to study the possibility of standardizing some basic components of electronic nuclear detection equipment.

46. A group of consultants on the checking, maintenance and repair of nuclear electronic instruments in developing countries will be called in 1965 to review the results of a course on this subject held in 1964 in Ceylon, to develop recommendations on standard instruments and tools required for the maintenance of nuclear electronic equipment.

47. Although it is expected that problems of reprocessing irradiated fuel by extraction with solvents will be discussed at the Third Geneva Conference, it is planned to organize in 1966 a conference devoted specifically to the problems of chemical and radiation stability of solvents used for reprocessing.

48. It is also expected that two years after the Third Geneva Conference it will be desirable to hold a symposium to review new types of control and safety instrumentation and data processing systems which the development of new types of homogeneous, fast reactors will bring about.

49. A symposium to discuss the progress made in miniaturization of nuclear electronics equipment for special uses, i.e. in space, is planned for 1966; it would also review the impact of this development on nuclear electronics in general.

50. The Agency also plans to hold in 1966 a symposium on recent developments in equipment for diffusion type processes such as leaching, liquid extraction, ion exchange, etc. These are of economic importance because they are used for processing of irradiated fuels.

IV. ISOTOPES AND RADIATION SOURCES

(a) Agriculture

51. The Agency will carry out its work in agriculture in consultation and close collaboration with FAO and, where appropriate, with other interested international organizations.

(i) Soil fertility and plant nutrition

52. Many developing countries are becoming interested in participating in the co-ordinated research programmes on the use of isotopes and radiation in rice and maize cultivation. The Agency plans to expand these programmes in 1965 and 1966 to meet the needs of these countries. A similar programme will be initiated for co-ordinated research on tree crops of agricultural importance to many countries. A symposium on the use of

isotopes and radiation in soil-plant nutrition studies, plant pathology and weed control will be held in 1965, and radiotracer measurements of plant nutrient supply, transformation and movement in soil and plants will be continued.

(ii) Irrigation, soil moisture and structure

53. It is now possible to make intensive studies on soil density and soil moisture measurements in the field by using portable radiation equipment. Such studies are prerequisites to the development of more efficient methods of water use in arid and semi-arid regions. Beginning in 1965, a staff member, well versed in soil water, soil physical problems and radiation techniques, will guide an Agency programme on the subject.

(iii) Insect control and radiation

54. By 1965 progress under the co-ordinated research programme on the use of the sterile male technique for the control of insect pests should permit initiation of pilot eradication tests on some of the fruit flies. Research on the tsetse fly and codling moth will be expanded. Regular distribution of the information circular on Radiation Techniques and their Application to Insect Pests to entomologists throughout the world will be continued.

55. The tropical ox warble "torsalo", the Australian sheep blowfly, the cattle grub and several species of ticks cause substantial livestock losses in developing countries. Since a number of areas of the world are affected, a panel will be convened in 1966 to advise on the possible application of isotopes and radiation for the control of these insects. A panel on the use of isotopes and radiation in the control of rice insects will also be convened in 1966.

(iv) Pesticides, weed killers and residues

56. Many developing countries are planning or are now establishing laboratories to study pesticide uses and residue problems. For such studies isotope techniques can often be used to greater advantage than conventional procedures. Member States are seeking the Agency's help in the matter and it is planned to have a specialist on the staff in 1965; a panel will be convened in early 1965 to help direct this programme.

(v) Plant breeding and genetics

57. The use of radiation in plant breeding has already resulted in a number of varieties of superior crop plants. Recent research has also clearly shown that the radiation technique may solve particular problems such as inducing resistance to certain diseases which cannot be solved by other breeding methods and that even if a problem can be solved by conventional methods, equivalent results can often be obtained much faster by using radiation. In 1965, a panel will discuss the status of radiation breeding in developing countries and how the Agency can assist developing countries in their plant breeding programmes using nuclear techniques.

58. To facilitate the application of radiation particularly in developing countries, a manual will be prepared on the use of induced mutations in plant breeding. Research contracts awarded by the Agency will be co-ordinated following panel recommendations in 1966.

(vi) Meat and milk production, animal disease control

59. Radioisotopes have special applications to many problems of mineral deficiencies and metabolism in ruminants. In 1965, a panel will discuss the role of radioisotopes and advise on the Agency's programme.

60. Of the many diseases in animals, helminths deserve special attention, partly because they continue to cause incalculable losses to domestic animals, and partly because ionizing radiation provides the only known way of making effective vaccines against the disease. Industrial production of radiation vaccines has already begun and encouraging preliminary work has been reported for others.

61. The Agency will, during 1965 and 1966, support research, fellowships and technical assistance requests related to the use of isotopes and radiation in animal nutrition and disease control.

(vii) Special Fund and other projects

62. During 1965 and 1966 the Agency will continue to act as the Executing Agency of the United Nations Special Fund project on the application of isotopes and radiation to agriculture in Yugoslavia.

63. The soil and climatic conditions of tropical and subtropical regions present many problems not encountered in the regions of the developed countries. These problems are best investigated in situ in research training facilities in tropical or subtropical regions where research workers from such regions would have the opportunity of applying radiation and isotopic techniques. Plans for such investigations will be initiated in 1965 with the help of two or three short-term consultants and a special mission.

(b) Food irradiation

(i) General

64. The wholesomeness problem associated with irradiated foods is in the process of being resolved and irradiated potatoes, bacon, wheat and wheat products have been cleared for human consumption in a few countries. Recent developments indicate rapid progress and the number of inquiries and requests to the Agency, especially from developing countries, are steadily increasing. It is planned to co-operate with FAO and WHO on a technical meeting in 1965 on the microbiology of irradiated food. A symposium on over-all progress in food irradiation is planned for 1966 or 1967 and a training course may be organized in 1966.

65. Three joint committees involving Agency support or participation will consider during 1965 and 1966 some of the problems of food preservation; one (Agency/FAO/WHO) will study the wholesomeness of food; a standing scientific committee (Agency/FAO/WHO) and a study group (OECD/ENEA) will discuss food irradiation.

(ii) Food preservation and processing

66. A panel on the preservation of tropical fruits and vegetables by radiation will be convened in 1966. It will study the inhibition of ripening, microbial spoilage and sprouting problems, all of high economic consequence to developing countries.

67. There is considerable hope centring around radiation pasteurization or sterilization of fish and meat products. Sterilization could be of particular importance in the tropics and subtropics where refrigeration is lacking and where the preparation and spicing of food would conceal flavour changes.

68. Sensitization of microorganisms by radiation is an important problem of food irradiation, since lower radiation doses would result in smaller changes in the food itself. With the assistance of consultants and a panel to be convened in 1965 the Agency expects to develop a co-ordinated research programme on the subject.

(iii) Food disinfestation

69. Regarding the disinfestation of food and the control of the transmission of disease, the Agency is making an effort towards establishing a pilot plant for grain disinfestation by irradiation. This involves special missions to interested countries to evaluate suitable locations and advise on the planning, financing and construction of the plant. Large-scale experiments in a programme of radiation elimination of harmful organisms from food and feed should begin with the aid of consultants.

70. It is estimated that in some tropical regions loss in the fish caught and dried due to insect hazards ranges from 25 to 60 per cent. Radiation has been successfully used to eradicate insects and the Agency has been urged to consider ways to use radiation methods in order to minimize losses of this nature.

71. Recent results from the use of radiation against the foot and mouth virus warrant further examination of the method. It is possible that the Agency will initiate during 1965-66 a programme on radiation inactivation of viruses.

(c) Radiation biology

(i) Dosimetry

72. The irradiation of biological systems (bacteria, plants, animals, as well as human beings) requires a quantitative knowledge of the energy imparted to the irradiated volume and its spacial and temporal distribution. Physical and radiobiological dosimetry and other related problems will be examined by a panel in 1965, and discussed in a symposium in 1966.

(ii) Radiobiology

73. Work with microorganisms is relatively easy and requires inexpensive equipment and a small staff. They are particularly suited for investigations of the response of living systems to ionizing radiation. It will be noted that recent progress in molecular biology has been achieved mainly with microorganisms. It seems advisable that studies be initiated with microorganisms on the radiation effects on the subcellular structures from the standpoint of altering their function. In order that the Agency should be able to advise and assist Member Governments, a panel will be convened in 1966.

74. The studies indicated above are a prerequisite for the understanding of the problem of modification of radiosensitivity in the use of radiation in medicine, agriculture and food. The Agency will also study the practical usefulness of compounds that influence radiosensitivity.

75. In some bacteria a repairing mechanism exists. Its absence increases the radiosensitivity of the cells to a considerable extent. The understanding of the molecular basis for this phenomenon would help to clarify differences in the radiosensitivity between various cancerous and normal tissues. A symposium on the radiobiological basis of modification of response to radiation will be held in 1966. A panel will be convened in 1966 to help direct and co-ordinate research contract activities.

76. Radiotherapy is concerned to a considerable extent with the acquisition of knowledge on the mechanism of action of ionizing radiation and collaboration between radiotherapists and radiobiologists will have to be stimulated.

77. A considerable amount of data on irradiation exposure of the human body to known dosages in defined anatomical locations exists in radiotherapy. Recent progress that has resulted from collaboration between radiobiologists and radiotherapists can be exemplified by the improved radiotherapy of bronchial carcinoma enabling intense radiation at 3 atm of oxygen. The potential application of protecting substances should also be considered in view of the need to prevent radiation-induced atherosclerosis. Excretion of substances, e.g. taurine, β-aminoisobutyric acid, steroids, etc., a few hours after irradiation is a phenomenon that might provide guidance for the further treatment as well as give clues to the physiological and biochemical changes induced by irradiation. The guidance and support of the Agency could be decisive in furthering co-operation between radiobiologists and radiotherapists. Accordingly a panel will be convened in 1965.

78. As a result of an Agency panel in June 1963 it became evident that the Agency should direct a co-ordinated effort of scientists from several countries to study the toxicity of ingested radionuclides and the biological action of incorporated radioisotopes. It is planned to hold a second panel in 1966 to review progress made in radiation protection.

Particular emphasis will be laid on radiobiological aspects. During 1966, a second panel meeting will be held to review progress made in radiation protection.

(d) Medicine

(i) General

79. The Agency's efforts to assist the development of nuclear medicine, especially of its physical aspects, through training, expert advice, research and information, have met with success in the developing countries. Certain projects are nearing completion, such as the co-ordinated research programme on the use of Ca^{47} and the international calibration of thyroid radioiodine uptake measurements. Research contracts, in the application of isotopes in medicine, have resulted in a better understanding of certain diseases such as congenital haemolytic anaemias, hydatid cyst disease and infestation with hookworm prevalent in some developing countries.

80. As foreseen in the Agency's long-term programme [4], the number and scope of the requests made to the Agency for advice and support in nuclear medicine have substantially increased in 1964. This trend is expected to continue in 1965-66. WHO will be invited to co-operate in all activities dealing with isotope and radiation source applications in medicine, with the ultimate aim of establishing a close link between the programmes of the two organizations.

(ii) Diagnostic and research applications

81. Two symposia are planned for 1965: one in either Latin America or Africa on the use of radioisotopes in tropical medicine; the other on radioisotope measurement techniques in medicine and biology. A similar symposium is proposed for 1966.

82. The research contracts programme in the use of radioisotopes in the study of endemic and tropical diseases will be continued in 1965-66, a panel of experts will be convened each year to advise the Agency in its work. It is expected that the number of requests for experts in nuclear medicine and for related equipment will continue to increase. The Agency will continue to grant fellowships and to provide basic training courses to scientists of developing countries. In addition, manuals and a film will be prepared for use in an advanced training seminar planned for 1965, primarily intended for persons actively working in medical isotope laboratories. The Government of Austria is considering the possibility of establishing an international medical isotope training and research centre [5] The Director General is prepared to give any offer of this type most careful consideration.

83. Many newly established reactor centres in developing countries have started to produce radiopharmaceuticals. During 1964, the Agency's Laboratory began a quality control programme for some isotopes and labelled compounds commonly used for medical purposes; preliminary results of this work will be available by 1965 and will be evaluated by a panel of experts to determine what guidance could be given by the Agency to centres in developing countries that plan to take up or expand their production.

84. The Agency expects to provide in the near future assistance in the use of isotopes in medicine. A panel meeting on the application of radioisotope techniques in endocrinology is therefore planned to be held jointly with WHO in 1966.

85. By mid-1965, the calibration and standardization of thyroid radioiodine uptake measurements will be completed. Approximately 200 isotope laboratories will have participated in the project. It is planned to initiate a project of a similar type, to be concerned with international calibration of equipment to determine the distribution of radioisotopes in the human body.

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[4] INFCIRC/50, paras. 31-45.

[5] See GC(VII)/OR.77, para. 6.

(iii) Toxicity of radionuclides in man

86. The co-ordinated research programme on the metabolism and toxic effects of radium and strontium-90 in the human body will be continued and the results consolidated. During 1965, a panel will review the present status of research on the toxicity of radiothorotrast with a view to co-ordinating the dosimetric, clinical and epidemiological research efforts of various groups, including the Agency's Laboratory. Another panel will review in 1966 new data on persons exposed to isotopes and advise on further action.

(iv) Therapeutic applications

87. The Agency has an important function in directing adequate attention of the developing countries that have radiotherapy facilities to the physical aspects of the use of isotopes and radiation sources. In this connection it will be necessary to consider, in 1965, the appointment of a second regional adviser on radiotherapy in one of the areas where projects of this nature are under way. During 1966, a second advanced international training course on the physics of radiotherapy will be organized. The Agency will also continue to act as an international clearing house for physical data needed for accurate radiotherapy and to provide such data at nominal cost.

88. In 1965, a panel will be convened to consider the dosimetric problems associated with the use of radiation sources for total body irradiation. Another panel on physical aspects of interstitial, intracavitary and surface therapy with radioisotopes will review in 1966 the progress of the Agency's work on this subject.

89. The small number of physicists in hospitals in developing countries did not warrant a panel discussion on the status of hospital physics in 1964. It is expected that in 1966 there will be enough physicists assigned in such hospitals and a panel would be of value to the countries concerned.

90. The Agency will continue to support the work of ICRU.

(e) Hydrology

91. In accordance with the recommendation by ECOSOC [6] stressing the application of science and technology for the benefit of the developing countries and the priorities established in the long-term programme for the Agency's activities, the programme for 1965 and 1966 aims at increased training in the application of isotope techniques to problems of evaluating and developing water resources. These techniques are of great economic significance to developing countries and the Agency's task will be to make such knowledge known and to assist in the provision of equipment and training of personnel.

92. The Agency has already carried out a number of field experiments. Investigation in Greece was completed in 1963 and the results are of importance in future development of water resources in the region. The field experiment in the Great Lake in Cambodia demonstrated that the Stung Sen does not contribute appreciably to the silting up of the Great Lake. Other investigations are still in progress in Turkey and Jordan, where the Agency acts as a sub-contractor to the Special Fund, and in the region of Trieste in Italy and Yugoslavia. The results of the latter investigation are expected to have an important bearing on the water requirements for drinking purposes and for the production of hydroelectric power.

93. The Agency's advisory and experimental service for the application of isotope techniques to the development of water resources has, during 1963, reviewed about 25 requests, eight of which developed into projects. The present rate of approximately four inquiries per month indicates that the increasing need for advice and assistance will necessitate an expansion of this activity. By 1965 it is expected that new techniques will be ready for wider use. Further practical guides will be prepared on these methods. The expansion

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[6] ECOSOC Resolution 980 (XXXVI).

must also be considered in relation to the Agency's contribution to the long-term programme of research and scientific hydrology sponsored by UNESCO. A preparatory meeting on this programme recognized the contribution of the Agency with respect to data on the isotopic composition of precipitation and assistance with the application of isotope techniques particularly to groundwater problems.

94. The Laboratory will continue to carry out short-term experiments in Member States where local facilities do not exist. The number of such field experiments is at present limited by the relatively small number of staff engaged in the hydrology programme. The Agency expects to act as a sub-contractor for work in isotopes in new Special Fund projects.

95. The use of isotope techniques must be coupled with the provision of suitable training. The present accommodation in the Agency's Laboratory restricts the number which can be trained. If more staff were available it would be possible to expand the scope of the Agency's assistance in the application of isotope techniques to include field experiments. Most of the techniques have been developed primarily by isotope specialists. Closer collaboration is desirable with hydrologists and hydraulic engineers. To some extent the Agency has tried to bridge this gap by meetings and by collaboration with staff of Special Fund projects. One meeting on nuclear geophysics is foreseen for 1965. In 1966 it is proposed to organize a second international symposium on the use of radioisotope techniques in hydrology, a symposium on low-level counting techniques to discuss various background components for different detectors, methods for their reduction, choice of shield materials, counter design and practical experience, and a panel to co-ordinate research contracts on isotope applications in hydrology.

(f) Industry

96. The literature survey on industrial application of radioisotopes covering the period up to 1960 which was published in 1963 was well received by industrial users. It will be appropriate to scan continuously and publish periodically the relevant information. In order to be able to advise developing Member States on the application of radioisotopes in industry the scientific staff of the chemistry section at the Laboratory should be increased. In this connection a panel will be convened in 1965 to discuss the applications of radioisotopes in industry, and a symposium is scheduled for the same year to discuss radioisotope instruments and their applications.

V. HEALTH, SAFETY AND WASTE MANAGEMENT

97. The study planned in 1964 on the adequacy and possible improvement of current techniques for the assessment of radioactive aerosols will be postponed to 1965 when a panel will be convened to prepare a manual on that subject.

98. In 1966 a panel will be convened, if possible jointly with ILO, to prepare a manual on practical methods of assessment of body burdens for radiation workers, including warning and action levels, on the basis of the general studies undertaken by ICRP.

99. The following manuals will be prepared with the help of consultants:

(i) In 1965: The safe use of isotopes in hydrological field research;

(ii) In 1965-66:
(a) Radiation shielding in typical operations such as storage of radiation sources in laboratories, field irradiation facilities as a complement to the general compendium on radiation shielding prepared in 1963;

(b) A revision, in collaboration with ILO and WHO, of the Medical Addendum to the Manual of the Safe Handling of Radioisotopes and the development of the part thereof relating to the organization of first aid facilities; and

(iii) In 1966:

(a) The safe use of isotopes in agricultural field research;

(b) The decontamination of premises and equipment;

(c) The use and efficiency of personnel protective equipment in normal and accident conditions; and

(d) Personnel dosimetry by other devices than film badges or ionization chambers (e.g. thermoluminescence, photo-luminescence semi-conductor, chemical dosimeters).

100. Research contracts will continue to be awarded for work of immediate concern to the Agency's activities in radiation protection.

101. The need for the provision, on request, of technical advice to Member States by staff members or outside experts on ad hoc problems of radiation protection is expected to increase. It is also intended to convene a panel of experts in 1965 to deal with some of the legal aspects of the transport regulations.

102. Regional study groups composed of health physics experts and representatives of developing countries will be convened to review radiation protection problems in those countries, the possibility of developing certain services in common, e.g. film badge services, and the use and adequacy of Agency safety manuals. One meeting is planned for 1965 in South East Asia and another one for 1966 in Latin America or the Middle East.

103. Where appropriate, the Agency will continue to apply its Health and Safety Measures [7] to projects with which it may be associated. As in previous years, some health and safety inspections will be undertaken. The Agency will also provide advisory safety assessments of particular installations and operations, upon request from the authorities in charge thereof.

104. With the help of consultants, manuals will be prepared in 1965-66 on hazards analysis for hot laboratories and, if necessary, to complement the code of practice of the Agency's Safety Standards [8] for research reactors. The preparation of a manual on safety evaluation of harbour and narrow waters for nuclear ships will be initiated in 1966.

105. The collection and distribution of data concerning the assistance available from Member States in case of a nuclear accident will be continued. Further developments of the Agency's mutual emergency assistance plan will be considered on the basis of a study undertaken in 1964, e.g. the organization of drills, the preparation of a manual on emergency planning jointly with WHO and FAO. The assistance of outside cost-free experts as well as of consultants may be required.

106. Study of the technical relationship of exposure to damage under the provisions of the Convention on Minimum International Standards regarding Civil Liability for Nuclear Damage, originally planned for 1964, will be postponed to 1966.

107. The Scientific Advisory Committee has recommended that the Agency should initiate co-ordination of national waste management research projects of broad interest to Member States, conducted by advanced countries at no cost to the Agency. In 1964 a panel of cost-free experts from those countries discussed topics amenable to co-ordination. In 1965 and 1966 some experts from these countries may be called upon to discuss certain aspects of waste management at panel meetings. Travel and living costs of participants would be borne by the respective Governments. Information on the co-ordinated research projects and the results obtained will be published for the benefit of Member States. Efforts will be made to extend this type of co-ordinated scientific research to other subjects.

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[7] INFCIRC/18.

[8] See para. 117 below.

108. In 1965 a second meeting of the panel on waste management economics will be convened in order to publish in 1966 a report on methods for economic analysis of waste management operations.

109. A series of technical reports on specific processes in waste treatment amenable to small-scale waste management operations will be issued. In 1965 a technical report on incinerators will be prepared with the help of consultants, and in 1966 a panel will prepare a report on the application of co-precipitation and flocculation-scavenger processes.

110. It would be desirable to conduct in 1966 a symposium on the disposal and storage of radioactive waste materials in the lithosphere and useful reactions with mineral materials.

111. A review will be made in 1965 of the Agency's efforts in the promotion of co-operative waste management operations such as international burial grounds between two or more Member States, in order to provide a basis for evaluating the desirability of a continuing programme and determining appropriate action.

112. The Agency's research contract programme will continue to support in 1965-66 studies of the fundamental processess of dispersal and release of radioactive materials into various environments such as atmosphere, marine, fresh water, lithosphere, and studies leading towards economically sound treatment and fixation processes particularly adaptable to small-scale applications.

113. The provision to developing countries upon request of ad hoc technical advice on practical problems in waste management will continue in 1965-66.

114. Further developments may require the help of consultants for another revision of the Agency's Basic Safety Standards. In particular factors for the relative biological effectiveness of high-energy particles will be examined in collaboration with ICRP; the Agency may continue, in collaboration with WHO and ICRP, the study undertaken during previous years of standards for permissible emergency doses to the public.

115. In continuation of the work on standards for luminous watches undertaken in 1964 in collaboration with ENEA, a review of hazardous radioactive consumer goods would be carried out with the help of a consultant, in collaboration with ENEA, WHO and ILO. Panels may be convened jointly with those organizations in 1965 and 1966 to establish safety standards in this regard.

116. The assistance of consultants will be required in 1965 to establish in collaboration with ILO standards for permissible radioactive surface contamination in working areas. These standards will be based on various national practices.

117. A panel will be convened in 1965 to establish a code of practice on radiation safety requirements in uranium and thorium mines, to become part of the Agency's Safety Standards. The panel will, if possible, be organized jointly with ILO.

118. In 1965, a panel will assist the Division of Reactors to review the Agency's manual on the safe operation of critical assemblies and research reactors and to prepare another manual on that subject, in order to establish a code of practice to form part of the Agency's Safety Standards.

119. The development of further data on criticality control in the transport of fissile materials and on the testing and design of transport packaging for radioactive materials, in collaboration with ISO, for incorporation in the annexes to the transport regulations, will be continued. It is proposed to develop methods of reviewing detailed packaging designs submitted by Member States, with a view to approving them as in conformity with the Agency's Regulations for the Safe Transport of Radioactive Materials. Several meetings of consultants will be required. If necessary, a general revision of the Agency's transport regulations will be undertaken in 1966. A panel will be convened for that purpose.

VI. RESEARCH AND SERVICES IN PHYSICAL SCIENCES

(a) Chemistry

120. During 1965, IUPAC will co-sponsor a symposium on thermodynamics of nuclear materials to disseminate thermodynamic data; a panel meeting to assess thermodynamics and related properties, and the publication of monographs covering thermodynamic and other physicochemical properties are also planned. In order to assess some of the data released at the symposium another symposium and a panel will be organized for 1966.

121. The collection and assessment of thermodynamic and other physicochemical properties will be continued, and two or three monographs on different nuclear materials will be published during the period 1965-66. In performing this work the Agency will continue to require the collaboration of outside specialists.

122. The Agency will continue to provide advisory service to centres in developing countries on the preparation and assaying of isotopes of practical importance and in the design of hot laboratories. An effort will be made to disseminate and evaluate information dealing with production processes, and to prepare further issues of the experimental manual on isotope production as the need arises.

123. An effort will be made to promote efficient utilization of research reactors in chemistry, in relation to research reactor programmes. In many cases a simple device on commonly available reactors could greatly enhance their usefulness. A survey and evaluation of such devices will be initiated by a panel to discuss special auxiliary facilities and loops in 1965 or 1966.

124. The establishment of appropriate pile dosimetry techniques is one of the fundamental requirements in performing research with reactors. A panel to review the current status and to define the problems of pile dosimetry was held in 1964. As a result of the recommendations it is expected to make, it is foreseen that work will be started in 1965 to explore certain pile dosimetry techniques.

125. In relation to chemistry programmes suitable for developing countries the following topics should be primarily considered: nuclear chemistry, hot-atom chemistry and radiation chemistry. The exploration of any of these is of academic interest as well as practical significance, and at the same time gives good training on various aspects of chemistry. The Agency will stimulate co-ordinated research in these topics in different parts of the world, through the Norway-Poland-Yugoslavia type arrangement or through research contracts.

126. Although in many developing countries nuclear energy programmes are concentrated mainly around reactors, it is essential to point out to them that for the preparation of a well-balanced programme there are important other irradiation tools such as neutron generators, accelerators and gamma sources. In this connection a panel to discuss the relative and intrinsic merits of reactors and accelerators in radiochemistry and in radiation chemistry is planned for 1965 or 1966. Four missions in 1965 and 1966 will be sent to developing countries to discuss reactor utilization in chemistry.

(b) Physics

127. Pulsed neutron research and reactor noise analysis as well as work in nuclear data have been introduced into the programme of the physics sections of the Agency.

128. Over the past several years there has been growing interest in studying transient, as opposed to static, techniques of reactor physics. The most notable example is the pulsed neutron source technique, which has been successfully used to study a wide range of neutron physics problems, including the determination of neutron diffusion and thermalization parameters, reactivity indices, and neutron energy spectra in reactors. In addition to its research applications, the pulsed neutron source provides an excellent training tool at very

low cost. These considerations commend the pulsed neutron technique to developing countries which are planning to initiate or expand their training and research facilities at minimum cost. Accordingly, a symposium on pulsed neutron research will be held in 1965 which will encompass theoretical and experimental research involving the use of neutrons pulsed-in-time as a means of studying the energy, space and time behaviour of neutrons in bulk media.

129. Reactor noise analysis is a relatively new technique for investigating the dynamic behaviour of chain-reacting systems of all kinds. It also provides an experimental method of investigating many reactor physics parameters with minimum perturbation of the quantities being measured. In its simplest form the method does not involve expensive instrumentation and can be easily adapted to any critical assembly or reactor, especially to systems operating at low power. The Agency is accordingly organizing a panel on noise analysis in nuclear systems which will be convened in 1966.

130. A symposium on inelastic scattering of neutrons in solids and liquids has been scheduled for 1965.

131. One important use of the neutrons produced in research reactors is in probing the structure of the solid and liquid states of matter. Such investigations need not involve expensive instrumentation, and the flux available from a low power research reactor is adequate for much useful work. Neutrons appear to hold considerable promise as a solid state physics research tool for use with low power research reactors in developing countries; consequently it is proposed to promote the development of this technique by research contracts.

132. Much has been learned in recent years about the characteristics of the fission process. This knowledge is fundamental to a thorough understanding of all fission chain reactors, and in particular to the more sophisticated power-breeder systems presently under development. In 1965 a symposium on the physics and chemistry of fission will be held. The exchange of ideas and data between physicists and chemists is expected to provide an up-to-date authoritative review of fundamental fission data for use by nuclear theorists and reactor designers.

133. Further work is required in neutron capture gamma radiation in fissionable materials It may be possible to study the neutron capture gammas from fissionable nuclei by using anti-coincidence between detected gammas and fission events (to exclude prompt gammas from fission). Spectra thus obtained could be compared with measured delayed gamma spectra from the major fissionable materials. A symposium in this field is scheduled for 1966.

134. The International Centre for Theoretical Physics will assist in planning a symposium on plasma physics and controlled nuclear fusion research which will be held in 1965 to consider developments since the conference held in 1961 in Salzburg on the same subject.

135. The International Nuclear Data Scientific Working Group has recently recommended activities which will eventually require a steady-state level of six to eight specialists on the staff. The operations of the nuclear data unit of the Agency and the compilation of data in the slow neutron and resonance regions began in 1964. Work on fast neutron data which requires access to high-speed digital computers is planned for 1965. Co-operation with other compiling groups is expected and independent critical reviews and analyses will be undertaken. Two panel meetings are being planned for each of the years 1965 and 1966.

136. A panel on neutron spectrometry will be convened in 1965 or 1966 to compare results and review progress in measuring distributed neutron spectra, particularly the problem of measuring spatial-dependent spectra in multiplying media.

137. One method of measuring neutron energy spectra is by using activation detectors, wherein the response of a series of detectors with different neutron activation cross-sections is determined in the spectrum under study. An important advantage of this method is that it effectively does not perturb the spectrum being measured. However, its full application in reactor neutron spectrometry must await more precise measurements of the neutron activation cross-sections involved. The Agency expects to encourage such work through the research contract programme.

138. The Agency may in future be called upon to participate in upper-atmosphere physics and space research. In this connection the Agency would confine its activities to perform standardization and regulatory functions which require world-wide co-operation and co-ordination. These functions can be expected to gain importance in respect of nuclear propulsion in space. The Agency has already participated in work relating to health and safety in space through co-sponsorship of the symposium "Man in Space" in Paris in November 1962. This limited participation will be extended through Agency sponsorship of an international conference in 1966 on those aspects of space research which pertain directly to the Agency's established interests in atomic energy.

139. More accurate and complete delayed neutron spectrum measurements, including individual delay-group spectra, are required for neutron effectiveness and kinetics calculations. The identification of the major delayed neutron precursors is also of practical importance to the design of high-temperature and circulating fuel reactors. Accordingly the Agency will promote such activities through the research contract programme.

140. A method of precise quantitative analysis for uranium-235 and other individual fissionable isotopes has recently been developed. The method is non-destructive and is independent of the chemical or physical form of the sample under study. It consists simply of counting the delayed neutrons emitted after suitable neutron irradiation, e.g. at a low power research reactor. The Agency plans to investigate this method in order to provide developing countries engaged in uranium and thorium prospecting, mining and refining with the information.

(c) The Laboratory

(i) Physics

141. The table below shows the Agency's programme of distribution of calibrated standards over a period of two years.

	1962	1963
Number of nuclides involved	12	17
Number of standards distributed	700	1136
Distribution to institutes	70	112
Member States	31	42

This service will be continued and expanded in 1965 and 1966 to include also soft beta emitters (C^{14}, S^{35}), nuclides which decay by electron capture and alpha emitters. In addition to short-lived nuclides, sets of calibrated gamma sources for the energy range between 50 and 2500 keV will be calibrated for distribution. Calibration of samples sent in by laboratories of Member States will also be carried out and special sources will be prepared upon request.

142. A study will be made to determine the most favourable chemical composition and physicochemical stability of standard solutions of different radionuclides, and the radiochemical purity of some commercially available radioactive preparations will be checked.

Nuclear data, relevant to the practical use of radioactive standards, such as half-lives, average beta energy, branching ratios in decay schemes, etc., will be checked or re-determined by microcalorimetric and/or counting methods.

143. The Laboratory will continue to participate in the international intercomparison programme of IBWM. In addition, and whenever a discrepancy between the calibrations performed in different laboratories (e.g. suppliers of radionuclides) becomes obvious, inter-laboratory comparisons will be arranged.

144. The calorimeters developed in the Laboratory have proved their suitability as primary standards for absorbed dose measurements, by experiments carried out in 1964 outside the Agency. Secondary standards, such as ionization chambers, chemical and solid state dosimeters for use in the field, especially in radiobiological research and for therapeutic purposes, will be calibrated, and will, upon request, be placed at the disposal of interested laboratories in Member States. Comparison measurements with primary standards will be performed in laboratories of Member States on request.

145. The measurement of some basic data, such as absorbed dose and determination of stopping power, will become possible in 1965-66 and will be undertaken using the 12 000 curie cobalt facility.

146. Depending on the availability of staff and equipment in 1966, measurements of slow and fast neutron fluxes in reactors will be carried out. Intercomparisons will be organized between interested reactor centres.

147. In support of its work in respect of health and safety the Agency is planning a service for the calibration of radiation monitors and dosimeters used in health protection determination. The programme would entail the preparation or purchase of sources of long-lived gamma emitters. The sources would be calibrated, then sent, on request, to Member States, with detailed instructions for use. Where appropriate this programme would be carried out in collaboration with the IBWM in Paris. However, lack of space will probably delay this work until 1966.

(ii) Chemistry

148. International intercomparisons of analytical techniques in nuclear materials will continue in 1965-66 along the lines suggested in 1961 by a panel of analytical experts. The programme will include not only uranium samples but also other materials of nuclear interest. At the same time it will be necessary to give more detailed attention to certain analytical methods for the determination of some of the more difficult trace elements in uranium.

149. Work on activation analysis applied to problems in chemistry has been proceeding at the Laboratory since 1963. In that year 506 samples were analysed. This will be continued and extended in 1965-66.

150. Laboratories in many countries require several types of analysed samples for radioactivation analysis. In order to meet the demand for these samples, the Agency will continue its efforts in this respect and will in addition promote collaboration among various laboratories.

151. Appropriate analytical services will continue to be offered to Member States and support will be given to such work as radioactivation analysis of the trace element concentration in the blood of individuals suffering from malnutrition; radioactivation analysis for studying solutions of normal and submerged soils; labelling of sand and mud for bedload transport; determination of trace element concentration in natural waters, etc. Work on the direct determination of trace elements in nuclear materials by mass spectrometry, coupled with isotope dilution analysis will continue. In support of the oceanographic studies carried out in the Monaco Laboratory, determination of trace elements in the marine environment will be made.

152. The investigation of the purity of commercial radioactive preparations, particularly those used for medical purposes, the devising of suitable analytical methods and the determination of certain specifications acceptable to the users will continue into 1965-66.

153. The chromatographic separation of tritium from hydrogen in small samples was successfully demonstrated. Investigations will be undertaken to increase the size of the samples and actual tests will be carried out.

154. The programme for the preparation of analysed samples of low-grade uranium ores and their distribution will be completed in 1965; the task of the Laboratory will be mainly to co-ordinate the work carried out by collaborating laboratories in Poland, Spain, the United Kingdom of Great Britain and Northern Ireland and the United States of America.

155. Work started in 1964 on analytical methods for the determination of uranium in fuel rod samples was also used to investigate the possibility of the establishment of a secondary chemical standard for uranium. This work will continue in 1965-66 on more advanced types of fuels as these become of interest.

(iii) Low-level radioactivity

156. The analysis and measurement of bio-assay samples will continue. The range of nuclides for which analysis is made will be expanded during 1965 to include soft beta emitters (H^3, C^{14}, S^{35}) which will be determined by liquid scintillation counting. An alpha spectrometer will be used for the simultaneous determination of alpha emitters.

157. The preparation and distribution of standard samples for the intercomparison of low-level radioactivity measurements and for the calibration of the equipment will be continued taking into account the recommendations of the panel held last October in Vienna. Standardized solutions of various radionuclides will be prepared in specific activities ranging from 1 pc per ml to 0.1 µc/ml. In addition, the following samples of environmental material will be prepared: milk (powder and evaporated), flour (rice), bone (ash), meat, vegetation, soil and water. These materials will be standardized with respect to Sr^{90}, Cs^{137}, I^{131}, Ra^{226} in specific activities ranging from 1 to 10 000 pc/kg or litre. The X-ray fluorescence equipment will be used in the analysis of minute amounts of certain stable elements in intercomparison samples.

158. Analytical and advisory services will continue to be provided to Member States and international organizations, for instance, air filters will be analysed for WMO air monitoring programmes, various bio-assay samples (e.g. urine, faeces, etc.) from Member States will be accepted for analysis.

159. Radionuclide determinations will be carried out in support of the rice and maize projects and chemical procedures will be performed as required in the preparation of calibrated radionuclide samples.

(iv) Agriculture

160. The field studies of the co-ordinated rice research contract programme in which investigators in eleven countries are participating, will continue to determine the best methods of fertilizing rice. Studies on the uptake of nitrogen and phosphorus, using N^{15}- and P^{32}-labelled material are needed. The Laboratory will be required to perform many of the radiochemical and N^{15} analyses in order to assure uniform results.

161. The use of fertilizers in maize growing areas in Asia, Latin America and Africa is rapidly expanding. The co-ordinated maize research contract programme in which so far four countries are taking part is designed to assist countries in these regions in determining the best methods of fertilizer use, particularly of nitrogen. Such investigations are of immediate practical importance and are best done by means of N^{15}-labelled material and

mass spectrometric analysis. The Laboratory will have to carry out most of the N^{15} analyses for the contractors and will also be involved in working out isotopic techniques useful in the evaluation of soil fertility with particular reference to tropical and sub-tropical soils.

162. The co-ordinated research contract programme on plant nutrient supply and movement in soil systems provides workers with knowledge on the diffusion phenomena from soil particles into solutions and from solutions to plant roots. The best method for the analysis of minute amounts of elements in soil solutions is by radioactivation. The Laboratory will assist most of the contractors in these analyses as well.

163. The Agency is developing a co-ordinated research contract programme dealing with the problem of elimination of Salmonella from foodstuff. This programme should be performed as part of the research and training activities in the Laboratory. It is specifically directed to investigate the radiomicrobiological aspects related to conditions in tropical and subtropical areas.

164. Applications of ionizing radiations for the preservation of food have already been approved by some Governments and rapid development of research in food irradiation and related areas can be expected. A number of problems, primarily of a microbiological nature, must still be solved. Lack of space and staff have limited the Agency's activities in food irradiation, but attention has been given to the study of methods of sensitizing microorganisms to radiation. The programme of the Laboratory could, if expanded, include the assistance to developing countries in using atomic energy to solve the problem of preserving food. The Laboratory will continue to collaborate in the fruit juice programme undertaken by the Government of Austria, ENEA and the Agency and to expand its in-service training programme.

165. The Agency will continue, through the co-ordinated research contract programme to assist countries in the applications of isotopes and radiation in entomology. The object is to utilize neutron activation analysis and tracer techniques to adapt the sterile male technique for the control of some of the most dangerous insect pests.

(v) Water resources development

166. Existing facilities provide for the electrolytic enrichment and for the measurement of tritium in natural waters. Approximately 150 analyses were carried out in 1963. By 1964 the capacity had increased to about 600 samples. At the request of Member States, the Agency is carrying out analyses of samples from Agency/WMO precipitation surveys and for sub-contractual work for the United Nations Special Fund groundwater projects. In order to meet the needs of interested parties, it is expected that an expansion will be necessary in 1966. In addition, if the present research sponsored under the research contract programme on the use of C^{14} for dating of groundwater proves feasible a provision for this service must be made. The expansion must also be considered in the light of the Agency's collaboration in the long-term programme of research in hydrology sponsored by UNESCO.

167. Some short-term field experiments which will continue to be carried out in Member States will take the form of joint co-operative projects between one or more Member States and the Agency. The type of service which can be provided will include the tracing of subsurface water, gauging streams, the measurement of velocity and direction of groundwater flow and the use of radioisotopes for siltation studies. In addition analytical facilities available will be used for the analysis and interpretation of the isotopic composition of natural waters.

(vi) Medical physics

168. Work with the whole-body counter will be continued and will also be used for the study of clinical problems, especially in support of research contracts. The external

counting studies on the living Vienna thorotrast cases will be completed and their results analysed. The Agency will continue to give assistance to several institutions engaged under Agency research contracts in follow-up studies of humans carrying radium and strontium-90 burdens.

169. Other in vivo assay techniques will be developed and applied especially in the localization of isotopes in the body, using a scintillation camera or scanners with moving detectors. The Agency plans to develop the application of neutron activation analysis for medical problems.

170. A therapeutic radiation dose measurement service will be established, taking advantage of newly developed LiF thermoluminescent detectors. These will be exposed in radiotherapy centres in developing countries, sent to Vienna and measured in an instrument to be set up at nominal cost.

(vii) Training

171. In 1963, a total number of 101 man-months' training was given to nationals of 17 different countries. The Laboratory is planning to accept in 1965-66 a number of fellows from Member States, for in-service training by international staff and using a variety of equipment that is or will be available for that purpose.

172. The number of openings in 1965-66 is shown in the table below.

Section	Number of openings at a time	Average duration in months	Subject
Physics	3	6-8	Methods of calibration of radionuclides and of radiation dose measurement. Determination of nuclear constants
Chemistry	4	8-10	Chemical and physicochemical analysis techniques for nuclear materials. Application of activation and mass spectrometry to chemistry and medicine. Use of ionizing radiation for food sterilization; gas chromatography; radioisotope applications in industry and other fields
Low-level radioactivity	4	6	Methods of analysis and measurement of radioactive contamination of bio-assay samples; X-ray fluorescence analysis of trace elements
Agriculture	5	8-10	Chemistry of soils, plant physiology research; radioactivation and mass spectrometric analysis applied to agricultural problems; use of labelling techniques
Medical physics	2	6	Whole-body counting techniques
Water resources development	2	3-4	Tritium enrichment and counting methods. C^{14} dating of groundwater. Isotope applications to hydrological problems
Electronics	2	8-10	Maintenance and repair of nuclear electronic equipment

(viii) Equipment

173. With the X-ray equipment donated to the Laboratory by a Member State, the following types of investigations will be further developed in 1965-66:

(a) X-ray fluorescence analysis of trace elements in:

(i) Biological materials;

(ii) Intercomparison samples; and

(iii) Isotope preparations;

(b) Investigations of grain-size and structure of metallic phases; and

(c) Investigations of the structure of certain colloidal systems related to soil sciences.

174. In connection with the projects described in paragraphs 141 and 142 above, devices such as a semi-conductor assembly for beta spectrometry, a counting system for the measurement of C^{14} and S^{35} in the gaseous phase and of nuclides decaying by electron capture and by alpha-emission, a radiation balance for the calorimetric measurement of high activities, etc. will be developed and put into operation.

175. In connection with the projects mentioned in paragraphs 149 to 151, 162, 165 and 171 the existing equipment used in activation analysis shall be renewed and improved, new detector systems should be acquired and put into operation by 1965. On the other hand, to make the activation analysis equipment more complete and versatile to enable training of fellows from developing countries which do not yet have nuclear reactors, a small neutron generator should be obtained and housed.

176. To meet the increased demand for analytical services from Member States in the applications of radioisotopes in hydrology, an expansion of the existing facilities in the water resources development section will be necessary by 1965 [9].

177. A mass spectrometer for N^{15} analyses and phytotron will be necessary by 1965 for the agriculture section. New apparatus in the medical physics section for therapeutic radiation dose measurement equipment for localization and scanning will also be required.

(ix) Space

178. All the working area in the laboratory building at Seibersdorf is already in use. The increased activities foreseen in the foregoing programme for the future may make it necessary to provide extra space, particularly for the agriculture section, in 1966.

VII. SAFEGUARDS

179. The Agency will continue in 1965-66 to apply safeguards to appropriate Agency projects and, at the request of the Governments concerned, to bilateral and multilateral arrangements. The Department of Safeguards and Inspection has acquired additional responsibilities as a result of the United States-Japanese bilateral agreement. Other bilateral agreements are also envisaged and additional staff would be required in order to cope with the work.

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[9] See para. 166 above.

Safeguards inspections of reactor facilities

Year	1961	1962	1963	1964[a/]	1965[a/]
Number of inspections	Nil	8	6	14	18

a/ Estimated number of inspections.

In addition, the anticipated transfer to the Agency of responsibilities under the United Kingdom-Japanese bilateral agreement may from 1965 onwards call for safeguards on the Tokai-Mura power reactor.

180. The review of the safeguards system for nuclear materials, nuclear reactors and small research and development facilities will take place in 1964. Later it is possible that the system will be extended to include facilities for fabrication of nuclear fuel and recovery of scrap, for reprocessing irradiated fuel and for the transport and storage of nuclear materials. It will be necessary in 1965 and 1966 to formulate detailed procedures for these facilities. The Agency expects to make arrangements with Governments for co-operation in the testing of these procedures on reactors and on nuclear materials processing plants.

181. Efforts to improve methods for nuclear materials accounting will have to be increased because of the extension of Agency safeguards to high-power reactors and nuclear materials chemical plants. These methods will include sampling and analysis of nuclear materials, such as unirradiated and irradiated fuel, reprocessing plant solutions and products from reprocessing plants. The Laboratory will assist in studies in methods of sampling and analysis of nuclear materials. A contract will be placed for the development of practical equipment for non-destructive analysis by gamma spectrometry following the establishment in 1964 of a feasible technical approach to the problem. Methods for non-destructive analysis of irradiated fuel elements, as well as other techniques related to the accounting of reactor fuel elements, will be further investigated. Contracts will be placed also for the development of practical equipment based on the most promising techniques.

182. A symposium on nuclear materials management and a panel on safeguards methods will be held in 1965. One symposium and two panels on safeguards matters are envisaged for 1966.

183. On the basis of preliminary investigations in 1964, contracts will be placed to develop methods for confirming the integrated reactor power by means of tamper-proof check instruments and for sealing reactors and nuclear materials stores.

184. The procedure for the approval of design, auditing of records and for making reports will be reviewed so as to ensure the optimum combination of effectiveness of Agency safeguards and minimum interference with the facility concerned. The possibility of using a computer for keeping records will be considered.

VIII. INFORMATION AND TECHNICAL SERVICES

(a) General

185. The Agency will continue, in 1965 and 1966, to carry out its statutory function of the exchange and distribution of information on the peaceful uses of nuclear energy through scientific meetings, scientific and technical publications, library and documentation services, and visual media.

(b) Scientific meetings

186. As recommended by the Scientific Advisory Committee, 12 scientific meetings are contemplated for 1965. These are:

(i) Symposium on the use of isotopes and radiation in soil-plant nutrition studies, plant pathology and weed control;

(ii) Symposium on radioisotopes in tropical medicine;

(iii) Symposium on radioisotope measurement techniques in medicine and biology;

(iv) Symposium on the physics and chemistry of fission;

(v) Symposium on pulsed neutron research;

(vi) Symposium on neutron inelastic scattering;

(vii) Conference or symposium on plasma physics and controlled nuclear fusion;

(viii) Symposium on thermodynamics of nuclear materials and atomic migration in solids in high-temperature reactors;

(ix) Symposium on exchange reactions;

(x) Symposium on physical, radiochemical and metallurgical research using small quantities of fissile materials;

(xi) Symposium on criticality control of fissile materials; and

(xii) Symposium on radioisotope devices in industrial and geophysical applications.

187. The list of subjects of the scientific meetings in 1965 will be adjusted, if necessary, to take account of the discussions at the Third Geneva Conference.

188. Other international organizations will, as appropriate, be invited to participate in or co-sponsor Agency meetings; the Agency for its part will continue to co-sponsor scientific meetings of other organizations on subjects which fall within its field of interest. Meetings will, as appropriate, be held in different countries.

189. For 1966 also, 12 scientific meetings are planned. The Scientific Advisory Committee has already recommended holding a symposium on effects of radioactivity in the marine environment, and a seminar on the monitoring of high-energy particles and interpretation of results. The Scientific Advisory Committee will be further consulted on the remainder of the conference programme for 1966.

(c) Publications

190. The Agency's publications programme for 1965 and 1966 will be developed along the same lines as hitherto. Rapid publication and inexpensive reproduction methods will remain the major objectives. Emphasis will be put on a more severe selection of papers accepted for publication and their concise presentation. An attempt will be made to replace, in some cases, the composition of the papers in the Agency by photographic reproduction from the originals.

191. The publication of the established series, including Proceeedings Series, Safety Series, Technical Reports Series, technical directories, and of reviews and documentary material itemized subsequently, will be continued. A small number of monographs will be added. It is estimated that the number of pages published will increase by ten per cent in 1965 and by another five per cent in 1966. All Agency publications except the Nuclear Fusion Journal will be printed and bound internally.

192. Due to the reduction of the Agency's conference programme in 1964, the number of conference proceedings to be published during the period 1964-65 will be reduced. This may result in some decrease in revenues from the Publications Revolving Fund.

(d) Documentation

193. The Agency will continue to provide on request, and where appropriate in collaboration with other organizations, assistance to developing countries for establishing or improving national and regional documentation centres, and for training of librarians and documentalists.

194. Preparation of the following publications will be continued:

(i) Atomic energy review;

(ii) Nuclear fusion;

(iii) Bibliographical series;

(iv) List of references on nuclear energy;

(v) List of bibliographies on nuclear energy; and

(vi) Supplements to list of periodicals in the field of nuclear energy.

Scientists will be invited to contribute papers for publication in the Agency's scientific and technical periodicals, and bibliographies will be prepared under contract by scientists outside the Agency.

195. It is planned to rent an electronic data-processing machine and auxiliary facilities for indexing and subsequent retrieval of scientific information. In particular, bibliographies, lists of references, lists of bibliographies and different indexes will be prepared automatically. Thus the Agency will be able to disseminate information in fundamental and applied nuclear sciences on the fullest possible scale. Key-words from abstracts to be stored in the computer will be prepared under contracts outside the Agency.

196. The exchange of abstracts in nuclear sciences in co-operation with international organizations, [10] will be continued. The active co-operation of the ICSU Abstracting Board will be enlisted. A meeting of the panel on scientific and technical information is planned in 1966 for the purpose of advising on various problems of scientific and technical information.

(e) Library

197. The Agency's Library has now been moved to newer and more spacious quarters, where newly-acquired material and periodicals can be better displayed. The Library Acquisitions List is being expanded to include all books. Collections will continue to be increased, with particular emphasis on abstracting journals and reference works.

198. The Library continues to serve both the Agency's staff and Member States. The following table shows the increase in the holdings of the Library and the number of requests handled.

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[10] Resolutions GC(IV)/RES/78 and GC(VII)/RES/150.

	1960	1963
Holdings:		
Books	11 010	22 793
Journals	541	730
Abstract journals	67	80
Microcards	18 330	38 382
Reports	10 502	21 351
Circulation:		
Internal	2 200	19 334
External (Agency material loaned to other libraries)	260	699

199. The number of books and journals available in the library at Seibersdorf has risen from 602 and 62 in 1961, to 1298 and 92 in 1963.

200. The Agency's film library continues to increase. Some additional prints of new films are purchased as required. The number of films available rose from 167 in 1962 to 203 in 1963; loans of films increased in the same period from 105 to 404.