



International Atomic Energy Agency

THE LONG-TERM PROGRAMME  
FOR THE AGENCY'S  
ACTIVITIES

## THE LONG-TERM PROGRAMME FOR THE AGENCY'S ACTIVITIES

On 1 October 1963 the General Conference adopted a resolution whereby it endorsed the long-term programme for the Agency's activities which the Board of Governors and the Director General had prepared at its request, and invited them to take the programme as a guide in planning and executing the Agency's work over the years, beginning in 1965 [1].

The long-term programme is reproduced in this document for the information of all Members.

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[1] GC(VII)/RES/151.

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### NOTE

All sums of money are expressed in United States dollars.

## I. I N T R O D U C T I O N

## A. G E N E R A L

1. At its fifth regular session the General Conference requested the Board of Governors and the Director General to prepare a long-term programme for the Agency's activities, which shall have regard to the difficulties of financing the Agency's operational programme. This document has accordingly been prepared taking into account the views expressed by the Scientific Advisory Committee, government experts and the Board of Governors.
2. The purpose of the long-term programme is twofold:
  - (i) To provide general guidance for the direction and scope of the Agency's work in the years to come; and
  - (ii) To define, in the light of past experience and expected future developments, what role should the Agency play in furthering the peaceful uses of atomic energy.
3. National long-term plans often contain detailed provisions prescribing not only the direction of activities to be undertaken, but also the scope and exact rate of implementation of projects over successive years. It was found inadvisable to adopt such a method for the Agency's long-term programme. The establishment of a programme along these lines would have taken more time and efforts than originally anticipated, and would have produced prognosis the more likely to be later disproved by actual experience. It seemed sounder at this stage to limit the programme to general guiding lines and directives sufficiently detailed, however, to permit further elaboration in the Agency's annual or biennial programmes, and to reflect their financial implications in the annual budget.
4. The long-term programme will begin in 1965. Once its planning has started it will become a continuous and evolutive process and should therefore be revised at regular intervals so as to bring its contents in line with new technological developments. The initial year should provide the basis for more detailed programmes for the next five or six years.
5. The long-term programme has been established on the basis of the present state of knowledge of atomic energy and in the light of the present and foreseeable technological development. A large degree of flexibility is essential in its implementation as its evolution may be considerably affected by scientific and technological developments.
6. It was already apparent in 1957 that some of the basic assumptions reflected in the Agency's Statute did not provide a realistic basis for an immediate programme of activities; this has affected the scope and character of the Agency's work. Recent technological developments however point to the possibility of atomic energy making its impact on economic and social progress somewhat sooner than expected. Increasing national efforts to develop atomic energy have been again taken up and should open broader possibilities for international action in the future. In this sense, the next few years should be envisaged as a period of transition and preparation from the Agency's point of view.
7. The Agency's role and principal task during this period will be twofold:
  - (i) To strive by international action, whenever such action seems to afford the most appropriate means, to assist in preparing Member States for the introduction of atomic energy in its manifold peaceful uses, and especially nuclear power; and
  - (ii) To stimulate and co-ordinate work on the development of science and technology with a view to making the advantages of the peaceful uses of atomic energy available to the maximum number of countries in the shortest possible time.

8. The long-term programme contains only few significant departures from the Agency's present activities. The direction and scope of the Agency's work at any time must obviously reflect the current technological, economic, financial and political circumstances; it would therefore be inadvisable to introduce new untested ideas and ambitious projects for the realization of which necessary conditions, especially as regards finance, do not exist. On the other hand, the adoption of the long-term programme should not later prevent the Agency from including new and feasible projects. The programme at this stage mainly reaffirms the Agency's goals and rationalizes the existing patterns of its activities, but there is no doubt that its successful realization would enhance the Agency's ability to undertake new and greater tasks.

9. The programme is based on the conviction that in time the Agency's most important contribution to economic development and general welfare will be in nuclear power. A gradual concentration of effort in that field is therefore necessary. For example the use of reactors to desalt sea-water on a mass scale and make arid zones available for cultivation holds great promise. The expected growth in the use of nuclear power will justify the Agency's continued concern with the problem of safeguards. At the same time, scientific and technological developments in the various applications of isotopes and radiation sources warrant continued and increased efforts to obtain as soon as possible, particularly in the developing countries, tangible results in medicine, agriculture, hydrology and industry.

10. Questions of health, safety and waste management are viewed essentially as an ancillary field where the solution of various existing problems may facilitate to a large extent the economic use of nuclear power and the application of radioisotopes on a wider scale. The international acceptance of safety standards and the publication of regulations and codes on this subject is of course the ultimate goal. During the coming years the Agency is also expected to enlarge the scope of its interests in the development of sciences and techniques related to atomic energy, by making full use of the existing research reactors and atomic energy centres where research can be combined with training on a national or regional scale in co-operation with established institutions of higher learning. Attention will be given to stimulating research, disseminating information, and centralizing documentation.

11. In technical assistance priority will be given to co-ordinated programmes of training, exchange of scientists and experts, provision of equipment and the grant of research contracts, but in every case methods of assistance will be adapted to the particular needs of countries.

12. Monographs on the Agency's activities in relation to the development of nuclear power and the application of isotopes and radiation sources reflecting the views of government experts are annexed to the present document. The monographs contain details which have been omitted from the relevant sections of the long-term programme.

## B. THE AGENCY'S RELATIONS WITH THE UNITED NATIONS AND THE SPECIALIZED AGENCIES

13. The increasing scope and cost of the activities of the United Nations and related agencies, and especially the growth of their operational programmes, have led to a growing emphasis on the need for closer co-ordination in the decisions of their governing bodies. This trend toward more effective co-ordination should be actively supported by the Agency and in particular closer collaboration with the United Nations, with which the Agency has a special relationship under its Statute, should be further developed. A notable example of such co-ordinated endeavour to focus international action on the problems of economic and social progress is the development decade. The Agency's long-term programme coincides with the second half of the decade during which period details of the Agency's programme will be integrated as far as possible with its objectives.

14. The Agency already participates in the United Nations Expanded Programme of Technical Assistance (EPTA) and is serving as executing agency for United Nations Special Fund projects. EPTA and the Special Fund will play an increasingly vital role in stimulating economic development during the decade. As a result of the growing interest of developing countries in atomic energy programmes, it may be assumed that a larger proportion of their requests under both programmes will consist of projects falling within the scope of the Agency.

15. The Agency should be prepared in principle to include in its own programme, if so requested, activities in atomic energy on behalf of the United Nations and related agencies. The work performed by the Agency in support of the programmes of the United Nations Scientific Committee on the Effects of Atomic Radiation is an example of such a delegated activity; it is logical that the Agency's specialized scientific staff and facilities should be taken advantage of for activities in various other branches in which atomic energy plays a role. In this manner the Agency could serve as an operational organ for atomic energy activities of certain programmes of the United Nations or of a related organization.

16. Although it may be sometimes difficult to draw a precise and rational division of activities between the Agency and some of the specialized agencies, close and continuous collaboration in the spirit of the various relationship agreements concluded in recent years is the best practical method of overcoming such difficulties. In these agreements the Agency is recognized as the body primarily responsible for international action concerned with the peaceful uses of atomic energy. It should be noted particularly that under the Statute the Agency has the specific obligation to establish standards of safety for protection of health and minimization of danger to life and property including such standards for labour conditions; these regulatory activities are to be implemented in consultation, and where appropriate in collaboration, with the competent organization of the United Nations and with the specialized agencies concerned.

17. The Agency will play its role in the new machinery for co-ordination which will be set up within the United Nations family following the recommendations of the United Nations Conference on the Application of Science and Technology for the Benefit of the Less Developed Areas. This will particularly affect power questions. In view of the considerable capital cost of power development it is imperative for developing countries embarking on new power programmes to examine simultaneously the advantages of conventional as well as nuclear power.

### C. REGIONAL ARRANGEMENTS

18. The United Nations and related agencies rely more and more on a regional approach in meeting common problems of countries in the same area. This tendency is reflected in the increased activities of the United Nations Regional Economic Commissions and in the establishment of regional offices of the specialized agencies. So far the Agency has met these problems on an ad hoc basis either by appointing regional experts or by organizing regional centres. It is possible that in the future decentralization of the Agency's work will require a more systematic approach in order to ensure more effective assistance to developing countries.

19. The ultimate economic effects of the Agency's work in various regions must be of growing interest to the economic commissions of the United Nations since the primary task of these commissions is the economic development of the regions concerned. When the need for organized regional arrangements arises the Agency might explore the possibility of integrating both the programmes of work and the administrative aspects, as closely as feasible, with those of the economic commissions of the United Nations.

20. The Agency should also maintain and develop the relations it has established with the regional organizations already set up in various parts of the world to foster the peaceful uses of atomic energy.

## II. SUBSTANTIVE ASPECTS OF THE PROGRAMME

### A. NUCLEAR POWER

#### Foreseeable trends

21. The development of nuclear power is advancing rapidly both in its technical and economic aspects. In the latter half of this decade nuclear power will become economically competitive with conventional power particularly in those areas where no indigenous fossil fuel deposits are available or where the cost of conventional fuel is high. This may even be true in respect of smaller stations of 50 - 100 MW(e) built in countries where conventional fuel is especially high. It is probable that more such situations will be identified in the near future. Furthermore, some degree of standardization of small and medium type reactors may well result in a decrease of their unit price and consequently increase their applicability especially in developing countries.

#### Summary of programme

22. The Agency should regard these expected developments as an enhanced opportunity to advise Member States upon request on their nuclear power programmes, particularly with regard to the economic feasibility of national or regional projects for nuclear power plants.

23. The Agency should also be prepared to give technical advice in connection with siting, reactor type selection and safety evaluation. It should further be prepared to meet requests for assistance beyond the purely advisory function, by preparing requests for United Nations Special Fund projects, acting as executing agency for such projects, and by securing nuclear fuel or, on request, helping to facilitate the financial arrangements.

24. It will therefore be necessary for the Agency to have on its staff not only scientific and technical specialists in nuclear power, but also a team of experts on nuclear power economics, and experts on conventional power, so that the advice given is based on an impartial evaluation of all existing alternatives of power generation. Since it is important to co-ordinate all work on power, the Agency should seek increased co-operation with the United Nations and other international organizations interested in power, including the International Bank.

25. In order to be in a position to give sound advice to Member States the Agency should undertake and promote a series of technical studies on problems of nuclear power economics, in accordance with a plan elaborated by a group of governmental experts.

26. While the Agency cannot itself lend active support to development and research work in nuclear power, except in some peripheral sectors, it should keep abreast of progress achieved by national institutions and continue to disseminate the result, generally on the same scale as heretofore. In addition the Agency could attempt to identify gaps in available information, the filling of which could be of particular assistance to developing countries.

27. It would seem worth while to hold at regular intervals a major conference for the purpose of reviewing technological progress contributing to the economically competitive utilization of power reactors. Particular attention should be paid to developments which might have a decisive influence on the future of nuclear power generation, such as nuclear superheat reactors and breeder reactors, as well as to developments of special importance, such as desalination reactors and small standardized power reactors, suitable for developing countries.

28. The Agency should be ready to help Member States or groups of Member States that take the initiative of launching joint research projects on nuclear power by such means as the provision of expert aid in programming, the grant of fellowships and research contracts and the supply of materials and equipment.

29. While a shortage of nuclear fuel is not likely to occur in the near future, the expected growth in nuclear power installations may modify the present world market with regard to uranium and thorium. The Agency should therefore continue to assist Member States upon request in their programmes of prospection for nuclear raw materials, fuel production and fuel element fabrication. Handling, storage and reprocessing of nuclear fuels are other aspects which may require attention in the future.

30. In providing training facilities special attention should be given to practical training, including on-the-job training in the design, construction and operation of power reactors, not only for scientists and engineers but also for technicians.

## B. APPLICATION OF ISOTOPES AND RADIATION SOURCES

### Foreseeable trends

31. At present the most widespread application of isotopes is in medicine; however, routine diagnostic procedures are not yet available to the majority of the world's population. Although therapeutic applications of radioisotopes are lagging somewhat behind, it is realized that radiotherapy sources are economical and easy to handle.

32. In most areas of the world the application of isotopes in agriculture is much less widely used. Since in most developing countries agriculture is of great importance there is considerable scope for development. While the use of tracers in the study of soil-plant relationships and the application of fertilizers could be initiated easily in many countries where a minimum of agricultural research is at present conducted, such large projects as grain disinfection and insect eradication are likely to require an effort for which large-scale help from outside would have to be forthcoming.

33. Application of isotopes in hydrology, where little is being done at present, will have great economic significance in studying the availability of groundwater, or the silt transport in rivers.

34. While it may take some time for the industrial applications of isotopes to make their full impact in countries with small-scale industries it may be to the economic advantage of such countries to introduce these techniques in industry at an early stage.

35. The various applications of isotopes as tracers and as sources of radiation entail comparatively simple and inexpensive equipment. Moreover, as more research reactors come into operation, many countries will start production of radioisotopes on a scale that will, in some way, meet domestic or regional requirements and make short-lived radioisotopes available to many areas for the first time.

36. All these factors favour a rapid development of isotope applications especially in the developing countries the economy and welfare of which will derive prompt and significant benefits from the introduction of isotope techniques.

### Summary of programme

37. The main emphasis in the Agency's activities should therefore be on the provision to the maximum number of countries of such fundamental and specialized knowledge, and as far as possible the supporting facilities, that are the prerequisites for the successful introduction of radioisotope techniques. Steps should be taken to encourage research for



the development of new techniques, or for the adaptation of existing techniques to the particular conditions of developing countries, as well as the dissemination of the results of such research.

38. It is desirable for the Agency to take the lead in promoting the use of isotopes and radiation sources in the less-developed countries; close and continuous collaboration with the specialized agencies and other intergovernmental and international non-governmental bodies would avoid duplication and would ensure efficient utilization of funds and manpower.

39. The order of priority which the Agency should observe in its work is indicated in Annex B. Such priority has to a large extent been established in accordance with the needs of developing countries.

40. The promotion of isotope work will entail the initiation and support of an increasing number of relatively small individual projects of varying nature.

41. The steady growth of scientific activities in developing countries will result in a progressive increase in the need for research contracts designed to support practical rather than fundamental work. A further increase in expenditures for research contracts in the applications of radioisotopes is therefore to be expected.

42. There is in addition a need for the Agency's sponsoring during the coming years two or three large-scale research projects, such as the continuation of fertilizer up-take studies and regional studies of plant pest control. Since funds for such projects are not likely to be forthcoming from the Agency's budget, external aid will have to be sought for such work.

43. A sizeable expansion of isotope work in the Laboratory will be needed to bring it into closer relation with the Agency's isotope activities in Member States. The work should include the development of isotope techniques applicable to particular problems in developing countries, and should offer opportunities for the training of scientists therefrom.

44. The need for fellowships and basic training courses in applications of isotopes is not likely to increase very rapidly. Emphasis should, however, be placed on improving the quality, and in many cases increasing the duration, of training. On the other hand, it is expected that requests for isotope experts will increase steadily and that in a few years the number of such requests may be twice as big as it is now. In view of the difficulties in and the costs of recruiting experts, better use will have to be made of their time by organizing technical assistance on a regional basis.

45. Equipment for isotope applications is comparatively inexpensive; but institutions in less-developed countries are usually short of funds and foreign currency. Requests for such assistance will no doubt increase. Accordingly, the proposal made by a group of technically advanced Member States to provide a number of medical isotope laboratories to less-developed countries deserves careful consideration.

## C. RADIOACTIVE WASTE MANAGEMENT

### Foreseeable trends

46. The foreseeable trends in radioactive waste management can best be discussed from the point of view of the various categories of waste.

47. In this decade the high-level radioactive wastes from fuel reprocessing plants will be a problem mainly for the advanced countries now reprocessing fuel. However, due to improvements in reprocessing techniques the volume of waste will probably be decreased. Higher burn-up as a result of improved reactor technology will also contribute toward lesser waste volumes. The advanced countries may be expected to continue with a

considerable effort in research and development, and, in addition, new methods such as pyrometallurgical reprocessing will be tested in practice.

48. The techniques of treating high-level radioactive laboratory waste are being continuously improved, resulting in smaller volumes of waste to be stored. However, the trend to release less radioactive material to the environment will increase the amount of concentrated waste and makes it necessary even for small nuclear laboratories to concern themselves with the problems of treating radioactive solutions and storing relatively concentrated liquid as well as solid wastes.

49. Intermediate-level radioactive waste is in one sense a separable mixture of low-level and high-level waste, but some cases require special consideration. More experience with treatment processes for various kinds of intermediate-level waste will be gained in various nuclear establishments; such experience, if collected and made generally available, could be extremely valuable.

50. With regard to low-level radioactive waste the main problem is to establish methods for determining operating control levels of activity for wastes which could be dispersed in various environments without hazard. While at present dose monitoring seems an adequate method there is a need to relate discharge to exposure by assessing the pertinent parameters. The formulation of systematic methods for establishing codes and standards should be the ultimate goal.

51. The Agency's role in waste management should consist of collecting and disseminating information by means of meetings and publications, and stimulating new research and development related to wastes from small centres and radioactive waste problems that may have an international bearing. With regard to some waste problems particularly prevalent in developing States the Agency should encourage, promote and, to a limited extent, conduct technical development work and research.

52. When requested, the Agency should provide direct technical assistance.

Activities undertaken by the Agency on its own initiative

(a) Collection, analysis and dissemination of scientific and technical information

53. Among the topics which would deserve special attention are the following:

- (i) Development of high-level waste treatment methods which are aimed at incorporation of waste fission products in inert solids, and the related development of appropriate long-term storage concepts;
- (ii) Technical and economic evaluation techniques for application to waste treatment processes now being utilized;
- (iii) Compilation of data and publication of an international registry of sea disposals of radioactive materials and complementary marine monitoring information; and
- (iv) Radioactivity dispersal mechanisms in fluid environments, including diffusion and other dispersal mechanisms in the atmosphere and in fresh and marine waters.

(b) Stimulation of new research and development

54. The scope of development and research conducted by the Agency must be rather limited. On the other hand, through its work in collecting and analysing available information, the Agency should be in a favourable position to identify important gaps in the existing research programmes. Research subjects which are not covered by existing

programmes and which are of significance to the waste management activities in developing countries may become the concern of the Agency.

55. The Agency should also seek ways of stimulating new research and development on such topics through influencing research trends in national institutions, favouring applicable research contract requests, and conducting appropriate panels or other meetings of experts designed to develop interest in particular subjects. Among the topics which currently need emphasis are the following:

- (i) Study of the effects of radioisotope materials in the hydrosphere, including demonstration of the accepted technique for establishing technical disposal limits for discharge of wastes into the sea. Fundamental studies of radioactivity in fresh and marine waters should continue to receive strong emphasis in the Agency's laboratories, especially in the Monaco laboratory;
- (ii) Development of simple inexpensive waste treatment methods for small-scale applications. The design and application of such methods should be described in an appropriate manual of waste treatment procedures;
- (iii) Methods for handling, processing, and disposing of radioactive solid wastes by inexpensive means appropriate for small installations located in densely populated areas;
- (iv) Development of equipment and services for treatment of gaseous wastes for application to the requirements of small-scale users; and
- (v) Methods for systematic assessment of waste management cost data from operating centres. This study would help new installations to formulate judgements concerning the direction to which their waste management activities should proceed.

56. While, in general, support of research in waste management by the Agency's research contract programme should play a subsidiary role, the award of such contracts should be utilized in the first instance to assist research in developing and developed countries on the problems pertaining to the management of wastes produced by small-scale reactors and centres. Other contracts could be granted in support of research which would have as an objective the solution of practical or specific operational problems in waste management.

(c) Special technical studies and projects

57. The information obtained from Member States as well as the results of research encouraged or conducted by the Agency should be analysed and studied by the staff of the Secretariat, and when appropriate with the help of panels of experts, with a view to establishing, as soon as feasible, a set of standards, regulations and codes of practice.

58. Other technical studies and projects should cover the preparation of a registry of disposal sites in the sea; the registry should include technical information regarding the quantities and form of waste disposed as well as information on possible effects, and the preparation of a study on the feasibility of establishing international burial grounds.

(d) Operational responsibilities

59. It is expected that the Agency's direct operational responsibility with respect to waste produced by its own laboratories and various reactor projects with which it may become actively associated will tend to increase. The Agency should, therefore, increase its efforts in solving the problems of waste management with which it might be faced directly.

Activities undertaken on request of Member States

60. The Agency should be prepared to assist in the training of specialists in waste management problems whenever the need for such specialists arises in developing countries, so that the lack of adequately trained personnel would not hinder the development of national nuclear power programmes. In addition to formal instruction training should also include practical work in an operating centre. In most cases a period of training up to two years may be required.

61. The services of experts for the selection, design and operation of waste management facilities may be needed on an increasing scale. The Agency should be prepared to provide increased assistance towards solving practical and specific problems of immediate significance for centres in the developing countries by the dispatch of missions, visits of its own staff or the provision of short-term experts.

D. HEALTH AND SAFETY

Foreseeable trends

62. As more nuclear projects are implemented in developing countries the need for assistance will increase. Therefore continuing health and safety guidance will be required either in the form of safety standards and technical manuals or in the form of technical advice on particular projects. Even with regard to advanced countries there are instances in which further development and exchange of information is necessary. Moreover, it would be advisable for the Agency to promote international co-operation in certain studies of health and safety problems.

Programme

(a) Work initiated by the Agency

63. In order to provide a sound scientific basis for its regulatory and advisory activities the Agency should continue to collect and digest information on development and research undertaken in the advanced countries. Whenever opportunity affords it may also endeavour to stimulate and co-ordinate research and development projects undertaken by national institutions. Visits by the Agency's scientists to important research and development centres and close co-operation with other international organizations working on the subject, such as the International Commission on Radiological Protection (ICRP) and the International Labour Organisation (ILO), are especially suitable methods of keeping abreast of progress.

64. The Agency should continue to provide advice with regard to the safety aspects of the simple uses of atomic energy, such as the application of radioisotopes, and with regard to problems common to all uses of atomic energy, such as monitoring practices. While keeping these subjects under continuous review, advice in matters of safety should be related to more advanced activities, such as mining and milling of nuclear ores, land-based or mobile power reactors and chemical processing plants. Symposia will often be useful prior to publication of data.

65. The problems relating to the design and testing of containers for the transport of radioactive materials and to the safety of shipments of fissile materials should be actively studied.

66. The Agency should not fail to attach high priority to studying the occasional incidents or accidents in nuclear establishments, as these provide a special opportunity for acquiring knowledge and experience.

67. Application of the Agency's health and safety standards and regulations to projects undertaken or assisted by it is a continuing task which may be expected to require a gradually increasing effort.

68. Co-ordination of certain health and safety work associated, for example, with work on whole-body counting, environmental study, methods of bio-assay and gamma radiography will be desirable.

(b) Assistance provided on request

69. The Agency's staff will probably be called upon increasingly for advice and assistance on the many special problems of health and safety which can arise in the operation of research centres in developing countries. It should be prepared to deal with most of these problems by correspondence, by special studies, by services performed in the Laboratory and by visits of experts to the countries concerned.

70. As the number of nuclear research centres grows, there will be a corresponding increase in requests for site and safety evaluations. The Agency should be prepared to respond to such requests by making available members on its staff or consultants, or by sending technical missions.

71. Co-ordination of international aid in the event of nuclear accidents must be regarded as still in the exploratory stage and the programme of aid should be expanded and adapted to experience.

## E. WORK IN THE PHYSICAL AND LIFE SCIENCES IN RELATION TO ATOMIC ENERGY

### General programme

72. In addition to its work in nuclear power and applications of radioisotopes, the Agency must maintain a lively interest in the developments of fundamental disciplines, especially physics, chemistry and the life sciences in so far as they are related to nuclear energy. Further progress will depend upon research in these sciences and the availability of trained scientists in the developing countries.

73. The Agency's activities in these sciences must be limited as regards both modes of work and the effort expended; since the scope and direction of the Agency's interest depend largely on unforeseeable circumstances it does not appear feasible at present to draw up a definite programme of future activities.

74. The main role of the Agency should be that of collecting, digesting and disseminating information, providing training and, to a lesser extent, stimulating research. Co-ordination with other international organizations will be of great importance.

75. The Agency should, however, also be alert to opportunities which may present themselves and participate actively in particular studies. It is, for example, vital to render assistance in the utilization of research reactors, as indicated below. Further examples of the kind of action the Agency may be called upon to take under this head are the establishment of a group of experts with the task of compiling and co-ordinating nuclear data, the encouragement and assistance of theoretical physicists from developing countries by the establishment of an international centre of theoretical physics or by other suitable means such as summer schools. Similarly, it has been suggested that the Agency might assist in bringing about future international projects, such as an accelerator of very high energy or a reactor of very high flux for research in solid state and nuclear physics.

76. So far the Agency has organized meetings and issued publications on work done in solid state physics, theoretical physics, plasma physics and thermodynamics. New topics which it may be desirable to take up include direct conversion, physics common to space and nuclear research, including radiological health and safety aspects of space exploration, interaction between radiation and matter, and radioactivity and radioresistance. The Agency's general aim in each should be to review the progress made and to assist in further promoting it on a broad basis throughout the world, especially as a result of exchange of information by means of symposia, expert meetings and publications.

77. The contribution which the Agency's laboratories will make to research under this head is described in section III.C below.

Assistance in utilizing research reactors

(a) General remarks

78. The simplest type of research reactor is expensive to build and operate, therefore its fullest possible use is of extreme importance. Used properly and intensively, research reactors do not only yield scientific information but also contribute to the development of national nuclear power programmes.

79. The Agency could render valuable service in encouraging the best possible use of research reactors, in co-ordinating Member States' research programmes and in exchanging information as to the results obtained. It should, therefore, be prepared to meet an increasing number of requests for such assistance and try to meet these requests, whenever possible, with an integrated programme of assistance covering a long period and as many subjects as possible.

80. With this in view, the Agency should maintain a keen interest in the following subjects:

- (i) Nuclear physics particularly as regards the use of research reactors of small and medium power;
- (ii) Physics of condensed state with particular emphasis on neutron diffraction methods, elastic and inelastic scattering experiments - including cold neutron techniques - and studies of radiation damage in solids;
- (iii) Reactor physics and technology, including neutron thermalization and diffusion studies, lattice experiments and shielding studies;
- (iv) Radiochemistry and radiation chemistry, including radioisotope production techniques and activation analysis methods;
- (v) Radiobiological and medical studies connected with neutron and gamma-ray irradiation; and
- (vi) Reactor operation problems.

(b) Work initiated by the Agency

81. In addition to assistance to newly-established research reactor centres the Agency should encourage co-operation and co-ordination between them and with older and advanced centres.

82. Regional study group and other meetings should be organized regularly to discuss the subjects mentioned above or particular aspects thereof. In addition, whenever necessary the Agency should convene panels of experts to assess progress in a particular part of research reactor work, with a view to suggesting further subjects of research, or co-ordinating parallel research carried out in different laboratories.

83. Whenever practicable, the Agency should encourage and support joint research ventures involving the use of research reactors and should in general seek to promote co-operation, including the co-ordination of research work and the exchange of scientists and information between neighbouring centres or centres engaged in similar work.

84. The award of research contracts can be an effective contribution to the programmes of a research reactor, and it is expected that a bigger proportion of the Agency's appropriation for research contracts will be assigned for that purpose. Such contracts may be particularly valuable in assisting small centres potentially capable of developing independent national programmes.

(c) Assistance provided on request

85. Simplified administrative procedures should be devised in order to speed up the provision by the Agency of small amounts of special materials and equipment needed in research projects.

86. Where experts are requested, the standard practice of sending one expert for a long period should not necessarily be continued. In order to develop a research programme it may often be more useful to send a scientist for short periods at longer intervals as the programme reaches the stage of independent work. The same purpose could be achieved by the use of regional experts and the establishment of close inter-laboratory collaboration.

87. The award of fellowships to several young scientists from the same laboratory for the study of closely related aspects of one subject would increase the possibility of it developing into an independent research programme. This method would help moreover to obviate a feeling of isolation from which scientists often suffer when they cannot exchange ideas with fellow workers in the same branch of science. Co-ordination of the fellowships programme with the provision of experts is also essential.

88. Research centres may need assistance in formulating their research programme or a specific part of it, and the Agency should be prepared to send upon request expert missions for this purpose.

### III. FUNCTIONAL ASPECTS OF THE PROGRAMME

#### A. ACTIVITIES INITIATED BY THE AGENCY

##### Encouraging research

89. Though the scope of the Agency's research programme will of necessity be limited, it can, through proper planning and judicious use of modest resources, provide an invaluable stimulus to the advancement of research in nuclear energy. The Agency should however keep a proper balance between the following three main methods of encouraging research and, whenever appropriate, combine all three in integrated programmes:

- (i) Stimulation and co-ordination of research in Member States without cost to the Agency;
- (ii) Support of research by the grant of research contracts; and
- (iii) Direct research activities conducted in the Agency's laboratories.

90. The Agency has an important role to play in stimulating fundamental and applied research projects which have a bearing on the development of peaceful uses of atomic energy to be undertaken by national or regional institutions from their own funds on individual or co-operative bases, but under the sponsorship of the Agency. Such projects should be carefully selected either directly by the Secretariat or with the assistance of panels of scientists from institutes likely to be interested in such ventures. The Agency's role should consist in initiating and, if possible, co-ordinating such research projects and subsequently publishing the results as part of its programme for the dissemination of information. For example, plans are under consideration for co-ordinated work in various countries on the radiotoxicity of incorporated radionuclides.

91. Research contracts have been used in the past for the financial support of research projects deemed to be of general value to Member States and specific interest to developing countries. The latter type of research contracts, which often served the incidental but important purpose of assisting scientific institutions or individual scientists in developing countries, should in the future be given higher priority. Among the wide variety of subjects deserving support, special attention should be paid to practical applications of isotopes and radiation sources in medicine, agriculture and hydrology as well as to research on local factors determining the siting of reactors and the type to be selected.

92. Research contracts in support of other projects should as a rule be part of an integrated research programme of general scientific or technological value. In some cases it might be appropriate to grant a contract so as to arouse interest in a particular research project, the funds for which would however have to be found subsequently from other sources.

93. While it is not possible to evaluate with any degree of accuracy future legitimate demands on funds for research contracts, it may be assumed that needs in respect of research conducted in, and for the benefit of, developing countries will increase. This tendency might be partially offset by a gradual decrease in awards of certain other types of research contracts, especially if the Agency succeeds in arranging for research to be carried out externally without cost to it. On the whole, however, an increase of expenditure for research contracts is to be expected.

94. Research in the Agency's laboratories should be devoted primarily to problems of an international character where the world-wide connections of the Agency can be brought into play (e. g. the international inter-comparison of analytical methods and the world-wide survey of tritium concentrations in water) or where work forms an integral part of a co-ordinated research programme also supported through research contracts, such as the



current rice research programme. The place of research activities within the over-all programme of work in the Agency's laboratories is described in section III. C below.

95. In furthering research the Agency must of course seek to ensure the necessary co-ordination with other interested research organizations with a view to avoid possible duplication of effort and obtaining the most fruitful results from the limited funds available.

96. The research programme sponsored by the Agency, whether supported by research contracts, undertaken in its own laboratories or conducted by outside institutions, will continue to require guidance and advice from panels of experts. Such panels have played, and will continue to play, an essential role in developing the Agency's activities in research, and particularly in helping to stimulate research projects undertaken outside the Agency and without its financial support. They have also proved to be the most effective means for the Agency's staff to keep abreast of recent scientific progress and of development plans in the more advanced countries. It may be assumed therefore that the need for panels of experts will increase gradually during the coming years.

#### Disseminating scientific and technical information

##### (a) General

97. The Agency's work in disseminating scientific and technical information must reflect the important developments which have taken place during the last decade, leading to an enormous expansion of scientific work, the proliferation of research centres and the transformation of research from an essentially academic endeavour into an undertaking actively sponsored and supported by governments and industry. The need for co-ordinated and organized exchange of such information has therefore become a major problem. A number of developed countries, having at their disposal considerable funds, have established large organizations for garnering and distributing scientific information.

98. An organized flow of scientific and technical information is of particular importance to developing countries, especially to those that have scientific potentialities the full use of which is hampered by organizational difficulties.

99. In general the role of the Agency is to foster the international exchange of scientific and technical information and supplement it when appropriate by its own activities with particular attention to the needs of the developing countries.

##### (b) Library collection

100. The Library is intended to have an international collection of scientific, technical, legal, administrative and economic publications relating directly to the peaceful applications of nuclear energy. In addition it must contain the main standard and general works on nuclear and natural sciences and technology. It has the twofold function of a research and reference library, serving the needs of Member States and of the Agency's staff.

101. The Library is in a favourable position to obtain research reports, documents, reprints and other unpublished material from Member States of which full advantage should be taken. The collection of references and abstract journals should be enlarged to cover not only nuclear sciences but also borderline subjects, such as theoretical physics, mathematical physics and applied mathematics. It might be useful to start also a repertory of information on scientists and educational and scientific activities in nuclear sciences, based initially on the information already available to the Agency.

##### (c) Information storage and retrieval

102. In the long run, the Agency may have to seek a satisfactory solution to the growing problem of information storage and retrieval in the use of special equipment and computers which may be utilized at the same time for other of its needs.

103. Increased use of microcards and microfilms, particularly for the collection of unpublished material, should be considered.

(d) Dissemination of information

104. The Agency should continue its work in the following activities:

- (i) Publication of lists of material received for the Agency's collections;
- (ii) Preparation and periodic up-dating of bibliographies based on a search of abstracting journals and of the original literature;
- (iii) Co-operation with international organizations, particularly the United Nations Educational, Scientific and Cultural Organization (UNESCO), and other documentation centres, in co-ordinating abstracting activities and organizing the exchange of abstracts. The Agency should co-operate in drawing up exchange agreements and extending such agreements on a multilateral basis in accordance with the programme for "Exchange of Abstracts" approved by the Board of Governors; and
- (iv) Participation in the development of a suitable multilingual system of classification, terminology and coding for studies covered by its activities.

105. Documentation on scientific and technical equipment and instruments should be further developed for the dual purpose of serving the internal requirements of the Agency in connection with the supply of equipment for technical assistance, research contracts, the Agency's laboratories, and as a source of information for Member States.

(e) Scientific meetings

106. In the Agency's programme of scientific meetings, emphasis should be accorded to certain topics of continuing interest on which it would be advisable to convene meetings at regular intervals. In particular, the Agency should study the advisability of convening a conference to review technological progress contributing to the economically competitive utilization of power reactors. Similar recurrent meetings should be envisaged on plasma physics, nuclear electronics, metrology of isotopes, dosimetry of radiation and application of isotopes. Priority may also have to be given to other specialized topics in the study of reactors, relating, for instance, to the development of fast and breeder reactors and the utilization of research reactors.

107. The list of subjects to be dealt with at Agency-sponsored meetings should be co-ordinated with other scientific organizations so as to ensure maximum coverage and avoid duplication. The number of meetings should be kept at the present level of about ten to twelve per year.

(f) Programme of publications

108. In its publications programme the Agency should accord priority to the proceedings of the Agency's scientific meetings in addition to panel reports, directories and scientific journals such as The Fusion Journal and The Atomic Energy Review. The over-all purpose of the programme should be to reflect the Agency's work and to give information on the latest developments in the nuclear sciences.

109. It is expected that the Agency will continue to rely on its internal reproduction facilities for the bulk of its publications programme. Production methods should therefore be continually reviewed so that maximum efficiency and economy may always be achieved.

(g) Assistance in documentation

110. On request, the Agency should be prepared to assist Member States in organizing their libraries and documentation centres in nuclear energy. The grant of fellowships and

training courses, the organization of library and documentation centres by Agency's experts and the provision, in special cases and to a limited extent, of auxiliary equipment, such as microreaders or document reproduction equipment, or subscriptions to periodicals will be the usual methods of rendering such assistance.

### Regulatory activities

111. The sections on health and safety and on waste management contain an outline of research and scientific studies to be undertaken by the Agency in preparation for and support of its programme of safety standards. The purpose of this chapter is to give an over-all view of the programme of regulatory activities, comprising the establishment of international norms for direct application by Member States or international standards to be used as a basis or model for national laws and codes.

112. These norms and standards, which are issued under the authority of the Board of Governors and the General Conference and take the form of international instruments or of recommendations, which are however binding upon the Agency's own operations, and may, by agreement, become binding upon projects assisted by the Agency, should be clearly distinguished from other forms of advice such as that contained in manuals or other types of material compiled and published by the Agency which lack either the formal character of the norms and the standards or their legal purpose and content.

113. The preparation of regulatory norms and standards requires a solid scientific foundation based on knowledge and experience of the subject in question, and in many cases considerable legal knowledge often of an innovatory or a controversial nature. Panels of scientific and legal experts will therefore continue to be convened to assist in the evaluation of scientific data and in the clarification of legal issues.

114. In order to achieve a set of standards to cover all main aspects of radiation safety, it is proposed to supplement and complete the standards already established for application to the simplest and commonest uses of atomic energy. It is also proposed to develop the general outlines of standards relating to more elaborate and less widespread types of operations which in a later phase may be gradually expanded so as to provide detailed standards for them as well. Similar principles will guide the organization of work on international norms. The Agency is well situated to assume an increasingly important role in this subject.

#### (a) Health and safety

115. The revision of the Agency's basic safety standards adopted in 1962 will be a task for the immediate future. The study should be supplemented by standards concerning the permissible emergency doses to the public.

116. Codes of practice should be developed in consultation with ILO and other international organizations on the following subjects: basic tasks and requirements of radiation protection services in small nuclear establishments, and essential requirements for adequate personnel, area and environmental monitoring; safety standards in mining and milling operations and standards regarding certain problems arising in chemical processing plants (such as protection against plutonium hazards or criticality hazards).

#### (b) Waste management

117. The preparation of a code of practice for the safe disposal of radioactive wastes by users of radioisotopes will be a task for the immediate future.

118. Depending on the progress of supporting scientific work, and in some cases on the clarification of underlying legal issues, work should be pursued on the following subjects:

##### (i) Standards concerning the safe management of high-activity wastes;

- (ii) Preparation of regulatory measures with regard to the disposal of radioactive waste into the seas, subject to consideration by the Board of Governors in June 1963;
  - (iii) Preparation of general standards for the safe disposal of radioactive wastes into fresh water; and
  - (iv) Elaboration of a legal framework for the establishment of international or regional burial sites for waste storage.
- (c) Transport of radioactive materials

119. While a revision of the Agency's regulations for the safe transport of radioactive materials is expected to be approved in 1964, further work will be necessary with respect to testing and design specifications for transport containers.

120. There is an urgent need for co-ordinating the relevant provisions of the various international instruments dealing with the transport of dangerous goods. The Agency should initiate and should play a leading part in this work, taking particular care to ensure that the rules are applicable to all geographical areas and all modes of transport.

(d) Reactor safety

121. More scientific research is needed before it will be advisable to prepare detailed Agency standards in reactor safety. The Agency should strive nevertheless to issue in the coming years safety standards of at least a general nature on such subjects as site safety assessment, safe operation of research reactors, safe operation of power reactors and safe use of harbours and canals by nuclear merchant ships.

(e) Compensation for nuclear damage

122. Following the adoption of a Convention on Liability of Operators of Nuclear Ships, in May 1962, the Agency will participate in the work of a standing committee which has been set up to deal with a number of residual questions, such as the possibility of establishing an international jurisdiction to hear actions for compensation for nuclear damage and the possibility of establishing an international guarantee fund with a view to enabling financially poorer States to meet their indemnification obligations. The Agency will also take part in the preparatory work for the revision of the Convention, scheduled to take place five years after its entry into force.

123. Once the convention on minimum international standards regarding civil liability for nuclear damage has been adopted the Agency may be called upon to co-operate in drawing up the relevant national laws and regulations and in elaborating regional conventions to implement these standards.

124. The important but very complex problem of State responsibility for damage caused to the nationals, territory and rights of other States will also require attention.

### Safeguards

(a) Foreseeable trends

125. Although it is not possible to predict accurately the rate of growth of the Agency's safeguards responsibilities, indications show that a gradual increase may be expected. It seems likely that most of this increase will be due to the Agency being made responsible for the administering of bilateral agreements between Member States, and to a much less extent due to the application of safeguards to the Agency projects.

126. So far the Agency has received no requests to assist Member States in establishing their internal systems for the control of nuclear material. However, with the expected gradual increase in the number of power and research reactors Member States may begin to request such assistance.

(b) Programme

127. General. The term "Agency safeguards" is at present related to safeguards against military diversion of nuclear facilities and nuclear material. The Agency's safeguards apply to Agency projects and to nuclear facilities and material to which such safeguards are applicable on a voluntary basis.

128. The implementation of the programme described below will depend on the number of facilities and projects actually brought under the Agency's safeguards during the coming years.

129. Safeguards provisions and procedures. The document setting forth the Agency's safeguards (INFCIRC/26) provides the basic guidance for the administration of safeguards by the Agency. The provisions of this document will have to be extended to cover reactors of more than 100 MW(t), plants for processing and fabricating nuclear fuel and scrap recovery, plants for reprocessing irradiated nuclear fuel and the storage and transportation of nuclear material.

130. In accordance with the decision adopted by the General Conference at its fourth regular session, the basic safeguards document should be reviewed in the light of experience obtained in its application and the technological developments. Such a review should be used to remove existing inconsistencies.

131. The Agency may have to undertake the preparation of additional provisions to cover such problems as the depositing of excess quantities of special fissionable material with the Agency in order to prevent its stockpiling [ 1 ]; providing security measures for storing special fissionable material; developing safeguards for the transportation of nuclear facilities and materials; developing safeguards of nuclear materials in possession of the Agency; and developing safeguards for merchant ships with nuclear propulsion.

132. Since the basic safeguards document lays down only general principles, additional detailed provisions and procedures may have to be developed, such as related to sampling of nuclear material, coverage of costs involved in the application of safeguards, production of small quantities of special fissionable material, and nuclear material losses.

133. General procedures, as well as detailed procedures for particular facilities, should be further developed for the accounting of nuclear material under safeguards. Production of special fissionable material in reactors requires supervision of the operation of the reactor by the Agency. In order to conduct additional and shake-up calculations access to a computer may have to be obtained.

134. General studies and development of technical methods. The preparation of basic data for the efficient application of safeguards may require various studies to be completed by the Agency, possibly with the assistance of other organizations.

135. In order to develop technical methods for the application of safeguards, various national nuclear centres may have to be awarded research contracts for studies such as:

- (i) Methods of identification of fuel elements;

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[ 1 ] Article XII. A. 5 of the Statute.

- (ii) Tamper-proof reactor instruments; and
- (iii) Non-destructive analysis of non-irradiated and irradiated fuel elements.

136. Work on routine methods for analysis of nuclear material samples and for the determination of the characteristics of facilities should gradually be taken over by the Laboratory.

137. Following the development of methods for inspection measurements suitable equipment will have to be procured.

138. Initial review of facilities and inspections. Facilities brought under Agency safeguards will require initial review so as to ensure that they will not further military purposes and that they will permit effective application of safeguards. The assistance of Agency reactor experts as well as of external consultants may be required.

139. As more facilities come under Agency safeguards, there will be a corresponding increase in the number of routine inspections required involving audit of accounting and operating records, controlling of reactor operation and nuclear material, comparing of the completed facility with the design; and reviewing the experimental programme carried out at the facility.

140. In order to ensure effective performance of inspections, new procedures should be developed which will include both general and detailed instructions worked out for the particular facility.

## B. ASSISTANCE RENDERED BY THE AGENCY ON REQUEST

### Needs

141. In order to meet the task of estimating future needs of Member States for assistance in training, the provision of experts and equipment and other forms of technical assistance, the Agency should undertake a study of national development plans in the peaceful uses of atomic energy, where such plans exist, and of the resources available for the support of such plans.

142. In general, the type and scope of assistance required depends on technical, scientific as well as specific nuclear development in the requesting countries. A description of the type of assistance most frequently requested by various countries of the same category from the point of view of their degree of development may be a useful method to provide guidance as to their needs.

143. Countries can be divided into four categories between which, however, there are no rigid dividing lines:

- (i) Countries that are taking the first steps towards technical, scientific as well as nuclear development. Approximately 20 per cent of the Member States belong to this category;
- (ii) Countries that have made some progress in introducing nuclear science and the application of radioisotopes in agriculture and medicine, etc. Approximately 25 per cent of the Member States belong to this category;
- (iii) Countries which have established, or have planned to establish in the near future, research reactors or sub-critical assemblies, or both, and already utilize the application of radioisotopes. Approximately 30 per cent of the Member States belong to this category; and

- (iv) Countries that have nuclear reactors for power production either in operation, under construction or in an advanced stage of planning, or are undertaking the improvement of industrial processes, and devoting substantial funds for research and development. Approximately 25 per cent of the Member States belong to this category.

144. The availability of trained personnel is of course of prime importance at all stages of development corresponding to the categories described above, and is a pre-condition for passing from one stage to another. The needs in training, as indeed the needs in other types of assistance, will vary, however, from category to category.

145. First category. Scientific and technical education will be a predominant requirement for this group of countries. The establishment of a nucleus of scientists and technicians capable of laying the foundation for the development of the various peaceful uses of atomic energy is a main problem. In that connection it is difficult to emphasize the importance of creating facilities for the teaching of atomic energy sciences at institutes of higher education. This matter is of such vital interest for the development of atomic energy that the Agency cannot refuse to provide assistance especially if such assistance is not obtainable from other sources. Close co-operation with UNESCO will be necessary, and in many cases the initiative will belong to that organization. However, whenever the assistance requested has a direct and close link with the development of atomic energy such as for instance in nuclear physics or radiochemistry, and no other aid can be substituted, it will be legitimate for the Agency to respond to the request. The most usual forms of assistance will consist of sending visiting professors.

146. Fellowships, especially for the training of future higher education instructors, and scientific equipment will play a complementary role. In addition, countries of the first category sometimes seek assistance in the application of radioisotopes in medical and agricultural work. Such projects are usually carried out in scientific facilities with a small staff and a modest amount of equipment.

147. Second category. Countries of this group include those that have made some progress in nuclear science and already have research institutions. Their requests for assistance are of a wider nature; their need for technical assistance is often characterized by a relationship to economic aspects such as increase of crop yields by proper use of fertilizers and in some cases development of new plant strains by induced mutations. The application of radioisotopes is mostly used as a new tool to assist them in scientific and technical work which has already been undertaken by conventional means. It is common for this group to request assistance in medicine, particularly in relation to diagnosis and therapy of diseases endemic in those countries. A further form of technical assistance commonly requested is in the prospection for and development of their nuclear mineral resources either for their value as an export commodity or as a provision for the anticipated future needs of the country in nuclear materials. Requests for assistance in water supply and irrigation projects in which tritium tracer methods are applied have been significant in recent years.

148. Requests for assistance in training from the second category of countries are expected to emphasize the training of specialists in various techniques in the application of radioisotopes, especially in agriculture, hydrology and medicine. Fellowships will play an increasing role. Training courses in the application of isotopes would also be of particular benefit for this group. Assistance will continue to be needed in fundamental nuclear education with emphasis veering gradually from visiting professors to fellowships for post-graduate studies.

149. Third category. This category consists of those countries that have established, or plan to establish in the near future, research reactors, sub-critical assemblies, or both, and make the widest use of the complete range of the Agency's possibilities for providing assistance. They usually have a comprehensive range of scientific institutions and possess

the main elements of technical knowledge necessary to enable them to obtain full benefits of nuclear technology. These conditions are not only desirable for the application of radioisotopes, but are necessary for the operation of a nuclear research reactor and the ancillary laboratory facilities. Such facilities can be most effectively operated in places where there is ready access to essential technical services, spare parts and supplies. This category of countries makes possibly the greatest volume of demands for technical assistance from the Agency. Their needs in training will become increasingly variegated and specialized. Requests received from them are often similar to those received from countries in the second group; in addition they also request assistance in health physics and radiological protection, and in some cases in metallurgical research, fuel elements fabrication, nuclear electronics and instrumentation, as well as in reactor construction, safety evaluation and research programming. Assistance in highly specialized applications of radioisotopes in industry, biology, entomology and in nuclear irradiation is often sought, while assistance in the raw materials field continues with the processing of uranium ores, production of uranium metal and fuel fabrication.

150. The need of countries in the third category for specialists in isotope applications, including applications in industry, will continue, and the training of reactor physicists and engineers, specialists in nuclear waste management, and health physicists will become of significance.

151. Fourth category. Even some of the highly advanced countries require outside assistance. Nuclear science is developing so fast that no country can be completely self-sufficient. Countries in this category, however, usually arrange for assistance through bilateral channels, and use the Agency's assistance only occasionally - in connection with highly specialized activities such as the evaluation of reactor hazards, fuel reprocessing and special metallurgical problems, and in some cases in connection with training in advanced or very specialized subjects.

#### Types of assistance

152. Fellowships. A larger number of requests for fellowships is to be expected due to the increasing membership of the Agency and also because some of the developing Member States are realizing the potentialities of the Agency's fellowships programme. This expected increase may be, however, to some extent compensated by the decrease in the number of requests from other countries. On the whole it is not anticipated that there will be any significant growth in the total number of requests. However, due to the need for long-term fellowships the resources required to meet such needs may nevertheless increase. In the first years of the programme, emphasis will continue on training of specialists in various applications of isotopes and on training in more fundamental disciplines, such as nuclear physics and radiochemistry. At a later stage it may be expected that a larger number of requests will be made for fellowships in special branches of applied sciences related to construction and operation of reactors, with special emphasis on the need for practical training in a reactor facility.

153. Visiting professors. A relatively large increase of requests for visiting professors is to be expected. With the development of national atomic energy programmes, interest will shift to the training of a larger number of specialists in the country itself. This need will be felt both in fundamental sciences related to atomic energy and in applied aspects of the use of isotopes and nuclear power. In some cases assignments of visiting professors for more than one year will have to be envisaged.

154. Training courses. The Agency, in consultation with its Member States and other international organizations, should be prepared to organize the following types of courses:

- (i) Specialized training in the application of radioisotopes in agriculture, medicine, hydrology and industry;
- (ii) Regional studies on the effective use of research reactors;



- (iii) Training on such selected topics as nuclear physics, radiochemistry, radiation chemistry, radiobiology, human bio-assay, radiation health and safety, use of high energy radiation therapy, etc.; and
- (iv) Refresher courses for members of the physics, chemistry and biology faculties of higher educational institutions.

Certain of these courses will have to be planned for a longer duration than was the practice in former years.

155. Regional radioisotope training centres. The Agency may be asked to assist in establishing regional training centres along the lines of the already existing Middle Eastern Regional Radioisotopes Training Centre for the Arab Countries.

156. The programme of research grants and scientific visits, though limited in scope, may prove to be a useful tool in assisting young scientists from developing countries in keeping abreast with scientific developments in advanced centres.

157. Mobile radioisotope laboratories. During the next few years, the laboratories will be used mostly in the countries that have become new Members of the Agency.

158. Experts. The fields in which the services of the Agency experts may be required in the next few years are described in the foregoing section on needs. A gradual increase in the number of requests for the services of experts is to be expected. Work in nuclear energy covers a wide number of subjects, and often an expert can only carry out his work successfully if he co-operates with other specialists on related subjects. In some cases it is therefore necessary for a country to receive assistance simultaneously in more than one branch of the nuclear sciences. Cases have been noted where a small group of experts working simultaneously in close co-operation would have been able to provide more effective assistance than the same number of experts visiting the country at different times. It is also believed that such a group of experts might successively serve several neighbouring countries and thereby effect savings in time and money. In some cases such savings could also be achieved if one expert serves as regional adviser a number of neighbouring countries, as for example in health physics and radiation protection.

159. Provision of equipment. There is no doubt that requests for scientific and technical equipment will increase considerably. The Agency, applying the principles governing EPTA, provides equipment only in conjunction with the dispatch of an expert. In view of the increasing demand for equipment and the lesser need for experts and because of the limited resources available to meet such requests the Agency should carefully study and formulate a policy on the conditions under which it would furnish requesting countries with equipment. Such a study should, among others, be directed to examining the question of whether under appropriate conditions it could supply equipment without sending an Agency expert.

160. Missions. The Agency cannot render effective assistance without remaining in close contact with the conditions prevailing in the requesting countries. While the number of preliminary technical assistance missions is going to decrease in the future, follow-up missions composed as a rule of a smaller number of participants will continue to play a very important and useful role. In addition the more frequent dispatch of members of the Secretariat must be envisaged. Such ad hoc missions may be required in any project of interest to the Agency, but it is expected that they will be particularly frequent with respect to projects in various applications of isotopes, including hydrology, surveys of economic feasibility of nuclear power, site and hazard evaluation, health, safety and waste management problems, utilization of research reactors, etc.

161. While each of the various methods of assistance enumerated above serves a separate purpose, it is expected that in the coming years emphasis will centre on such projects as will require a combination of various types and methods of assistance. As an example, the promotion of effective utilization of research reactors may involve missions and experts,