REVIEW OF THE AGENCY'S ACTIVITIES

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INTERNATIONAL ATOMIC ENERGY AGENCY

REVIEW OF THE AGENCY'S ACTIVITIES

1. The Board of Governors has reviewed the activities of the Agency during the first 25 years of the Agency's existence, pursuant to paragraph 1 of resolution GC(XXVI)/RES/399 adopted by the General Conference in 1982.

2. In October 1983, the Conference, having noted the progress which the Board had made in conducting its review of the Agency's activities, requested the Board - in resolution GC(XXVII)/RES/421 - to submit its report on the matter to the General Conference at its twenty-eighth regular session.

3. The attached review is submitted to the General Conference pursuant to that request.

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I. INTRODUCTION

1. At its 26th session the General Conference, in resolution GC(XXVI)/RES/399, requested the Board, in consultation with the Director General, "to conduct a review of the Agency's activities over the past 25 years to study the best ways and means to respond to the growing needs of the developing countries in the peaceful uses of atomic energy". A progress report was submitted by the Board to the Conference at its 27th session, and the Conference, taking note of it, requested the Board to submit its report on the matter at the 28th session.[1/]

2. In acting upon the request for this review, the Board has taken note of the ten-year review of the Agency's activities which it made in 1967 [2/] and of the need to ensure that the fullest use is made of the Agency's capacity to provide assistance to its developing Member States.

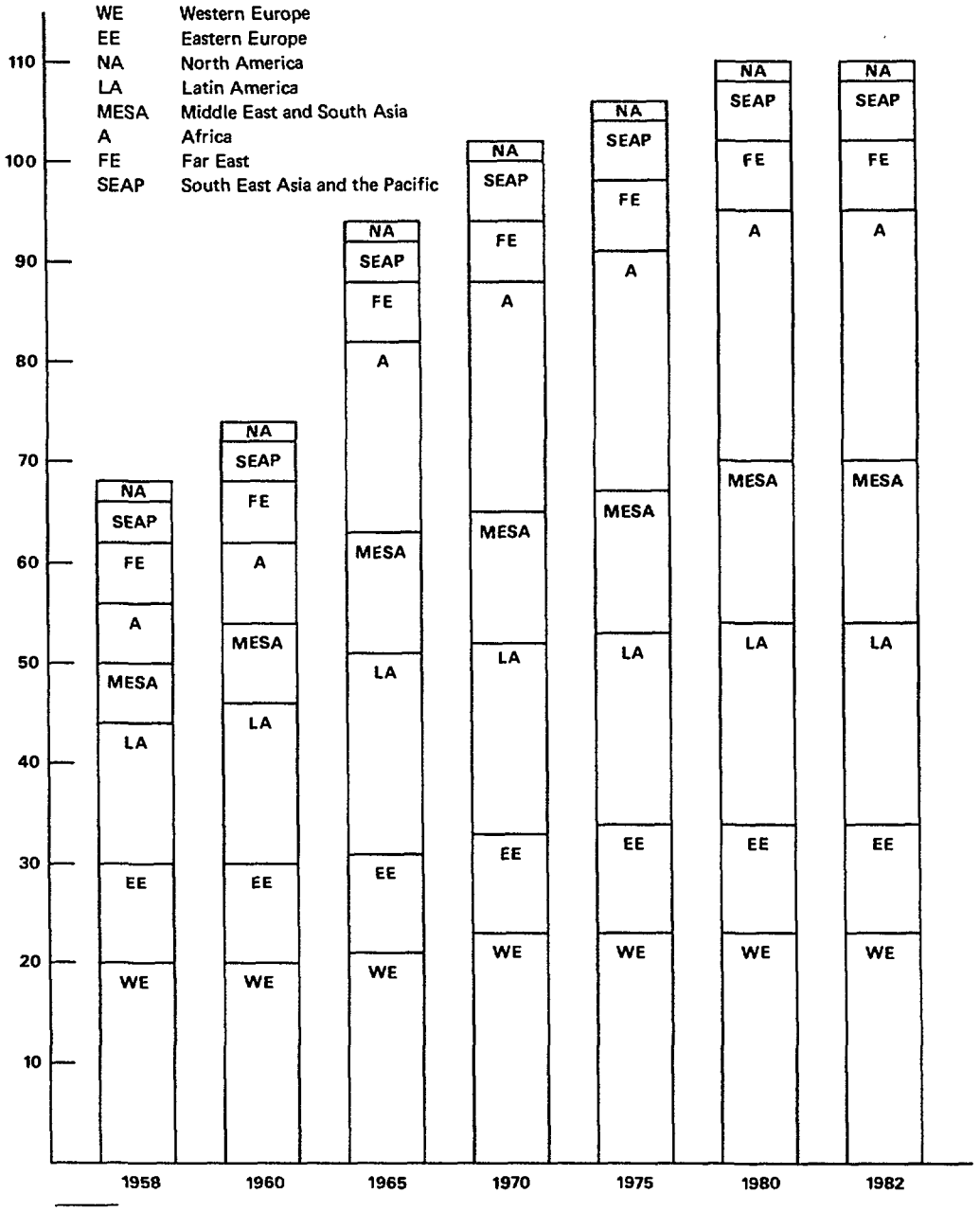
3. The Agency's present programme is highly diversified. Several factors have combined to make it so. The pattern has been set by the Statute, by the state of the art in various branches of nuclear science and technology - which in some instances has been directly affected by Agency activities - and by the requirements of Member States. Clearly different Member States have different requirements, so that developments in certain specific fields do not have the same relevance for all Member States, but the Agency's programme in its entirety is designed to serve the whole membership.

1/ See GC(XXVII)/RES/421.

2/ See GC(XI)/362 and Addenda.

4. The membership of the Agency increased continuously during the period covered by this review; the most recent member (the 112th) acceded in January 1984. Growth in the Agency's membership over the past two and a half decades, by region, is shown in the following chart.

GROWTH, BY REGION, IN NUMBER OF MEMBER STATES*



* Membership at year-end.

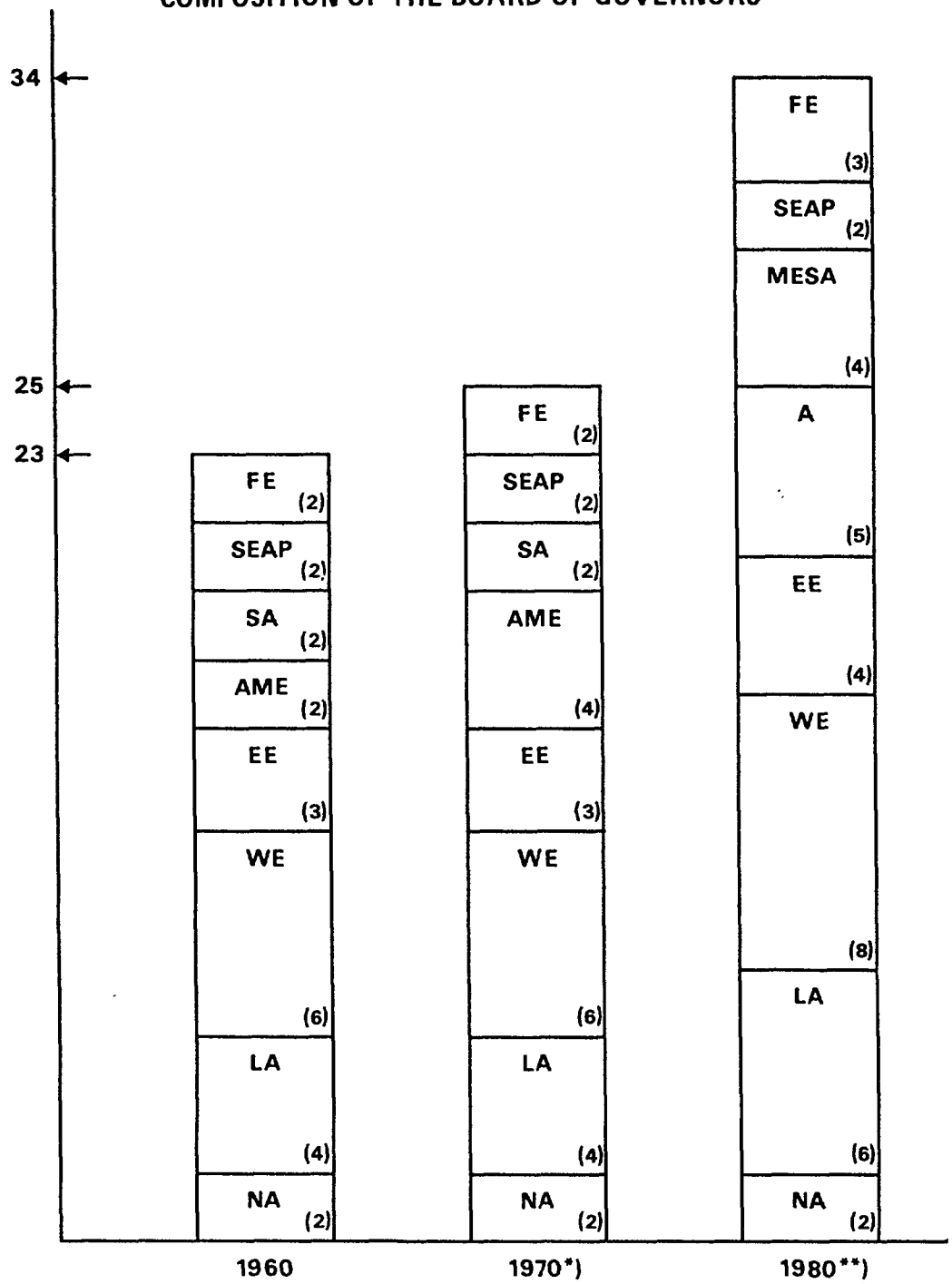
5. This growth in overall membership has resulted in changes in the size and composition of the Board of Governors. A number of resolutions concerning these aspects have been adopted during the past 25 years by the General Conference. A resolution which was adopted by the Conference in 1960 and which entered into force in 1963 had the effect - inter alia - of increasing the size of the Board from 23 to 25 members, and one which was adopted in 1970 and which entered into force in 1973 had the effect - inter alia - of increasing it to the present level of 34 members. 3/ Since 1977, the question of amending Article VI.A.2 of the Statute has been before the General Conference and the Board of Governors, and in both of these bodies it has been the subject of extensive discussion. In the resolution on this subject which the General Conference adopted by consensus in 1981 (GC(XXV)/RES/389), the Conference requested the Board of Governors to consider and submit its observations and recommendations on proposed amendments with a view to giving equitable representation to the under-represented areas. Discussion is continuing in the Board on the implementation of that and related resolutions. 4/

6. The changing size and composition of the Board over the period are reflected in the following chart.

3/ See GC(IV)/RES/85, GC(V)/RES/92, GC(XII)/RES/241, GC(XIII)/RES/261, and GC(XIV)/RES/272.

4/ See GC(XX)/RES/353, GC(XXII)/RES/361, GC(XXIII)/RES/370, GC(XXIV)/RES/378, GC(XXV)/RES/389, GC(XXVI)RES/403 and GC(XXVII)/RES/420.

COMPOSITION OF THE BOARD OF GOVERNORS



NA	North America	AME/ A	Africa and the Middle East/ Africa ***)
LA	Latin America		
WE	Western Europe	SA/ MESA	South Asia/ Middle East and South Asia ***)
EE	Eastern Europe		
		SEAP	South East Asia and the Pacific
		FE	Far East

*) The first amendment of the Statute (Article VI.A.3) came into force on 31 January 1963, resulting in an increased membership of the area of AME.

**) The second amendment of the Statute (Article VI.A. D) came into force on 1 June 1973, and Article VI as it now stands is the result of that amendment. Since then the Board has consisted of 34 members. The third column represents the composition of the Board as at 25 September 1980. The specific composition varies from year to year because of the rotation system agreed upon informally in relation to elections under Article VI.A.2(b) and (c) of the Statute, affecting the areas of A, MESA, SEAP and FE.

***) With the amendment of 1 June 1973 the areas of AME and SA became the areas of A and MESA.

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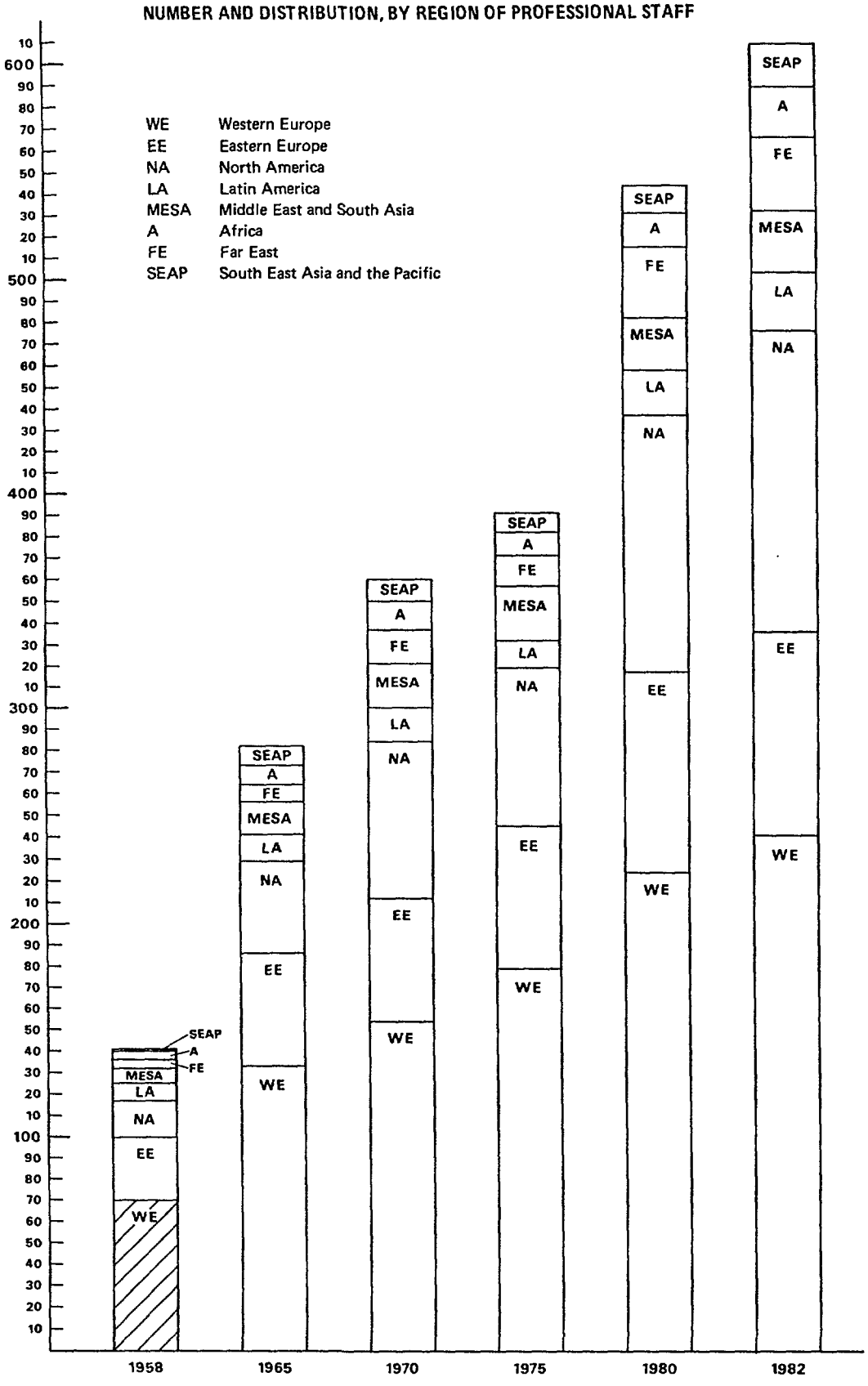
7. Within the Secretariat there has been a substantial increase in the number of staff and a gradual change in its composition, as indicated in the following chart in respect of Professional staff. Beginning in 1981, the question of the staffing of the Secretariat has also been a matter for consideration at the General Conference and the subject of considerable discussion within the Board of Governors.[5/]

8. In the resolution on staffing of the Secretariat which the General Conference adopted by consensus in 1981 (GC(XXV)/RES/386), the Conference requested the Director General to take immediate steps to increase substantially the number of staff members drawn from developing areas at all levels, and particularly at the senior and policy-making levels, and to make maximum efforts to rectify the existing imbalance over the course of the next four years; also, it reaffirmed that no post, including that of the Director General, should be considered the exclusive preserve of any Member State or group of States and that all posts at all levels should be considered open to appropriately qualified candidates from all Member States.

5/ See GC(XXV)/RES/386, GC(XXVI)/668, GC(XXVI)/672, GC(XXVI)/672/Add.1, GC(XXVI)/RES/401, GC(XXVII)/694, and GC(XXVII)/RES/419

NUMBER AND DISTRIBUTION, BY REGION OF PROFESSIONAL STAFF



9. Two additional points should be noted in relation to the review which follows. First, a comprehensive approach has been adopted and an attempt has been made to consider all aspects of the Agency's programme over the past 25 years. This has been done because a more limited approach might well involve the omission of certain elements which would significantly affect the outcome. Secondly, this review is an evaluation in a limited sense only, for the purpose is in fact to seek improved means of assisting the developing countries; the process of evaluation has thus inevitably concentrated on this aspect.

10. Consideration of these two points has resulted in a different treatment of one particular part of the Agency's activities, namely that of the Department of Safeguards. Because safeguards constitute an important part of the Agency's activities, no review of the past 25 years could be complete without information on this subject. On the other hand, safeguards are a unique activity which is conducted by the Agency in the interests of all Member States, and in fact of the world at large. Therefore, it was believed to be inappropriate to examine safeguards in the same detail as other Agency activities when seeking improved means of assisting developing countries. The discussion of safeguards in the review has thus been confined to the minimum necessary for an overall picture of the 25-year period under study.

11. An effort has been made in the presentation to differentiate between the various technical programme activities and the mechanisms employed to carry them out. The presentation therefore differs somewhat from that in earlier Agency review papers, but it is felt that greater clarity has thereby been achieved. Some difficulties arose in presenting statistical information because of various organizational regroupings within the Secretariat over the period; certain subject groupings in this review therefore differ from the present organizational structure, as is evident in the combination of nuclear power with the fuel cycle and of nuclear safety with waste management.

This is not considered a major problem, however. The basic indicators of programme activity are presented for five periods of five years each. Broadly speaking, the first such period may be considered the period of initial development, the next three periods the expansion phase, and the final period more of a consolidation or refinement phase - a phase which is still continuing.

12. It will be noted as well that - with one exception - the review deals solely with the programmes and mechanisms developed within the Secretariat, and does not consider specifically the functions of either standing or ad hoc advisory bodies which have played a role in the formulation of the Agency's programme plans; in a few instances, however, extra-Secretariat bodies which have been active in programme implementation are mentioned. The exception referred to above is the Committee on Assurances of Supply, which - although it is a committee which was established by the Board of Governors - is included here under the heading "The Mechanisms".

13. Finally, references are made in the text to those General Conference documents - primarily resolutions - which are considered of direct relevance to the material covered and which might thus serve to provide additional background information.

II. MAJOR PROGRAMME TRENDS OVER THE PAST 25 YEARS

1. The Programmes

A) Nuclear Power and Fuel Cycle

a) Nuclear Power

14. At the time when the Agency was established, there were only three pilot-scale nuclear power plants in operation in two Member States; however, a number of countries were operating or installing research reactors. These were seen as primary tools for the acquisition and development of nuclear science and technology. It was thus natural that the reactor programme initially focussed on the exchange and dissemination of information concerning reactor design, technology and operating experience which existed with respect to both power and research reactors.

15. It was soon clear that research centres often experienced difficulties in launching viable research and development programmes based on their new research reactors; this was one conclusion drawn from the preliminary assistance missions sent out at the time. The programme of mainly regional meetings on research reactor utilization launched in 1961 became a useful means for exchange of experience among centres which were often at a similar stage of development.[6/] In one case, these meetings led later to closer active collaboration under the Regional Co-operative Agreement (RCA) for Research, Development and Training Related to Nuclear Science and Technology.

16. It is worth noting that, as reflected in a number of Resolutions adopted by the General Conference, even during the earliest years the Agency's advice was sought by Member States in planning nuclear power programmes.[7/] The provision of such advice became, over the years, an activity which was developed to a high degree of sophistication.

6/ GC(II)/RES/29 and GC(V)/RES/106

7/ GC(11)/RES/27, GC(III)/RES/57, GC(IV)/RES/86, GC(V)/RES/109 and GC(VI)/RES/127.

17. Following the initial few years, the next phase was marked by the attainment of industrial-scale, commercial application of nuclear power beginning in the mid-1960s, by optimism and the rapid ordering of new plants in the late 1960s and early 1970s, and also by a rapid increase in the plant sizes available on the market from 200-400 MW(e) to 900-1300 MW(e). It appeared that a number of developing Member States were considering setting up nuclear power projects but were facing problems with the large unit size as well as with financing. These points were discussed by the General Conference and several studies were made by the Secretariat, including a sizable market survey in the early 1970s. 8/

18. The nuclear power programme during this period focussed on planning for nuclear power introduction and applications; use was made of the increasing competence in nuclear power economics and technology, and sophisticated planning methodologies were developed by the staff of the Secretariat. Nuclear power planning studies were carried out with some 20 developing Member States, always with the objective of transferring the methodologies for continued use in Member States. The WASP methodology for power system planning was developed and gained acceptance by Member States and by the World Bank and other financing institutions as a useful tool for power system investment planning.

19. In some cases the nuclear planning studies were followed by detailed feasibility studies, site reviews and project planning assistance. In one Member State this resulted in a first nuclear power plant project being launched; in other cases specific projects have not as yet been initiated. In several cases, the Agency advised Member States to delay nuclear power introduction. During the later part of the period it was recognized that nuclear power planning advice must go beyond economic considerations and include the strengthening of

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8/ GC(XIII)/RES/256, GC(XV)/RES/285 and GC(XVII)/RES/302.

national infrastructures - in particular qualified manpower at all levels, but also electric grids and organizational and industrial support infrastructures. Manpower development was identified as the most urgent problem and was initially approached through a programme of general and specialized nuclear power training courses which were launched in 1975. This developed into a comprehensive manpower development programme using all means available including advisory services, technical co-operation projects and major UNDP projects. In one case a UNDP project was executed to assess the industrial potential in a country for participating in construction and component manufacture for the first nuclear power plants to be built there.

20. A specific problem in relation to nuclear power planning assistance was the unavailability of smaller power reactors, originally conceived of as being in the 50-100 MW(e) range and later of any size up to 400-600 MW(e). The larger sizes increasingly used and in some cases standardized for the markets in the industrialized countries inherently limited the number of developing countries which could use them through simple considerations of grid size and stability.[9/] Since the late 1960s the Agency has tried to interest plant manufacturers in providing small and medium power reactors (SMPRs) specifically for use in developing countries. The "Market Survey for Nuclear Power in Developing Countries" carried out in 1972-73 had as one major objective the demonstration of the considerable potential market for SMPRs. However, new designs for smaller power plants would, by definition, encounter also problems of demonstrated reliability and economic performance if such plants had not been built in industrialized countries.

9/ The problem had been identified already in General Conference Resolution GC(II)/RES/27 in 1958, and in the early 1960s the Agency participated in several studies on small and medium sized power reactors.

21. The optimism of the mid-to-late 1960s also applied to new applications of nuclear power, in particular low-temperature heat uses (e.g. desalination).[10/] Several studies, including site-specific ones, were carried out in this subject area but no plants were built and the effort was scaled down towards the end of the period.

22. The preparation of a series of guidebooks was initiated in the mid-1970s in order to provide general advice on nuclear power introduction and manpower development and also check-lists for specific activities such as bid preparation and evaluation.

23. The systematic collection and dissemination of nuclear power plant operating experience started in 1970 and developed into a series of publications which was particularly welcomed by project managers and plant operators in developing countries.

24. In connection with the NUSS programme, quality assurance codes and guides were developed and a series of guidebooks planned for the application of QA/QC measures in the field. These codes and guides benefited from the fact that in their formulation considerable attention was paid to their use by plant owners.

25. The economic recession in the late 1970s led - with a few notable exceptions - to a slowing down of nuclear power programmes, and developing countries for which nuclear power could mean decreased dependence on oil imports were in many cases forced to delay nuclear power programmes for financial reasons in spite of obvious long-term economic benefits.

26. The International Nuclear Fuel Cycle Evaluation (INFCE), did, however, also highlighted the need for adequate infrastructures in developing countries.

10/ See GC(IX)/RES/197.

27. Against this background it was natural that the expansion of the Agency's nuclear power programme was stopped and the programme instead focussed on the consideration and further development of existing possibilities with no major new initiatives.

28. The Agency's economic planning capabilities have been improved through the addition of methodologies such as the MAED model (Model for Analysis of Energy Demands) for making forecasts of electricity demand related to overall national development plans. This has in the past been a weak point in nuclear power planning studies as national forecasts have often been unrealistic. An indispensable tool for all advisory services has been the energy and economic data bank (EEDB), which contains key data for all countries. The WASP methodology was further developed and made available to all Member States, and close co-operation with the World Bank developed in power planning and project assessment.

29. Additional emphasis was given to assessing and developing the infrastructure needed to support the introduction of nuclear power. By the end of 1982 nearly 1200 trainees from 55 developing countries had participated in the nuclear power training courses. Efforts were increasingly devoted to establishing education and training (e.g. in QA/QC) in Member States through technical assistance and UNDP projects. Particular attention was paid to national education and training programmes for nuclear power technicians, and the Agency's advice became increasingly sought for the establishment of national nuclear manpower programmes; an average of two advisory missions a year have been requested over the past 3 years.

30. A manpower development guidebook provided a yardstick for assessments of manpower needs and a guidebook on the introduction of nuclear power provided a basis for evaluating organizational structures. Attention subsequently became focussed on developing a similar basis for assessing the industrial support required for the construction and operation of nuclear power plants. During this phase a guidebook on power plant-electric grid interaction was also published.

31. Some positive signs have become visible in regard to the availability of SMPRs. Several nuclear power plant manufacturers have developed at least conceptual designs for power plants of about 300 MW(e) which are based on proven systems. A study will be devoted to clarifying the provenness of these designs and the costs of construction at reference sites in developing countries. By diminishing the uncertainties in regard to such plants it may prove possible to overcome the hesitation of financing institutions.

32. Information on operating experience has been collected in a computer file which makes it possible to analyse specific aspects of operation, such as outage causes. This is now available to Member States, several of which have requested specific data sets and analyses.

33. The QA code and guides having been almost completed, activities at the end of the period turned towards assistance in their application both through advisory services and through guidebooks.

b) Fuel Cycle

i) Nuclear Materials

34. The nuclear fuel cycle begins with the exploration, extraction and processing of uranium and thorium, the two nuclear raw materials. Since its inception the Agency has been deeply involved in collecting and disseminating technical and economic information on uranium geology, exploration and resource evaluation techniques, and on mining and ore processing methods. The main direction of the Agency's work in this field was to obtain the relevant data from uranium-producing countries and to make these data available to developing countries so as to assist them in finding, producing and marketing their indigenous resources.

35. The need for information on uranium prospection was established by the numerous monitoring missions sent to Member States in 1958. By 1959 the first technical co-operation project on uranium geology had been started. The number of projects increased quickly, reaching 13 by the end of 1961. In 1961 the Agency issued its first publication related to uranium exploration and evaluation; it was soon followed by one on uranium ore processing.

36. Responding to the growing interest in nuclear raw materials, in 1963 the Agency organized a first symposium on health and safety issues related to uranium mining and processing. In the following years several technical meetings were held on specific problems in finding and producing uranium; the proceedings of these meetings were made available to all Member States. Over 30 publications on this subject were issued and all of them have had wide distribution.

37. The collection and evaluation of data on uranium resources, production and demand became a regular activity of the Agency in the mid-1960s. In this field the Agency has co-operated extensively with NEA/OECD in publishing a biennial report commonly known as the Red Book. This publication achieved early recognition as the most authoritative work of its kind and by the end of the period enjoyed a very large distribution.

ii) Fuel Performance and Technology

38. During the initial years, attention was paid more to the properties of materials for use in fuel elements rather than to fabrication processes and performance.

39. In 1960 the Agency organized in Vienna an international symposium on "Fuel Element Fabrication with Special Emphasis on Cladding Materials". At that time the interest was not yet specialized, and nuclear fuel elements for power plants and for

prototype and research reactors were considered together. In later years, there were a number of meetings held to review such aspects of fuel fabrication technology as quality control and assurance and fuel performance.

40. In 1976 the Agency established an "International Working Group on Water Reactor Fuel Performance and Technology" in response to the increased interest in this area, and all related Agency activities began to be carried out with the assistance of and in accordance with the advice provided by this group. Since then the Agency has organized each year two specialists' meetings devoted to various subjects concerning nuclear fuel performance, such as pellet-cladding interaction, fission gas release, and computer modelling of fuel behaviour.

iii) Spent Fuel Management

41. At the initial stage the efforts of the Agency were directed towards the exchange of information on the behaviour and properties of irradiated fuels. Many aspects of reprocessing - such as the chemistry of uranium, plutonium and fission products and, to a certain extent, the technology and design of reprocessing facilities - were discussed at a number of international meetings, including the United Nations International Conferences on the Peaceful Uses of Atomic Energy held in Geneva.

42. Responding to the growing accumulation of spent fuel and to interest in reprocessing, the Agency initiated in 1975 a study on regional fuel cycle centres (RFCCs). Specific features of large RFCCs established on a multinational basis were evaluated. The results of the study were encouraging. From certain points of view, specifically of non-proliferation and economies of scale, considerable advantage could be derived from an RFCC approach to fuel cycle activities, in contrast to the alternative of States setting up their own, smaller plants. The activities under way at the end of the period concentrated mainly on the storage of spent fuel, because of the urgency and importance it had assumed.

B) Nuclear Safety and Waste Management

a) Nuclear Safety

43. The Statute specifies the Agency's responsibility for setting nuclear safety standards. As nuclear power programmes have started and grown, and as public attention has focussed on the safety aspects of nuclear power, this responsibility has assumed increasing significance. Setting safety standards involves promoting a consensus among countries as to what safe practice is and disseminating information in various ways. The Agency, in which there are Member States at various levels of nuclear power development and which is able to draw on experience from all parts of the world, has a unique capacity in these areas.

44. One of the first tasks was to assemble information from Member States on their existing safety practices and regulations and information from organizations on work already in progress on the formulation of codes. In the early days, occupational radiation protection was the main focus of interest. Therefore, as an initial step it was considered important to provide users of radioactive sources with a manual of practice for the safe handling of such sources. The manual, completed in 1958, was the first of the Safety Series publications of the Agency.[11/] Then it was decided to obtain more information on certain technical and medical aspects of radiation safety which were not as well established as the general principles presented in the manual; hence technical and medical addenda to the manual were prepared. Soon after, work began on other safety standards, guides, codes of practice and manuals.

11/ See GC(III)/RES/54.

45. Another area where uniform international standards were highly desirable was the transport of radioactive materials. The adequacy of transport standards affected liability insurance requirements for shipments, especially where large sources were involved. By 1960 the first internationally recognized regulations for the safe transport of radioactive materials had been approved and published in the Safety Series.[12/]

46. In 1962 the Basic Safety Standards for Radiation Protection were released.[13/] Based on recommendations of the International Commission on Radiological Protection, this document set limits for the radiation exposure of workers and the general public. It was followed by publications dealing with such topics as the organization of radiation protection programmes, the physical and medical surveillance of workers, and personnel and area monitoring.

47. When safety standards, codes and guides were being developed in the early years of the Agency's existence, there were wide gaps in knowledge about the effects of radiation to which UNSCEAR had drawn attention. The Agency therefore sponsored research on various subjects related to radiobiology, problems connected with the pollution of the sea by radioactive wastes and radiation dosimetry. Attention was also paid to problems of the pollution of fresh water, to safety aspects of nuclear propulsion and to questions of legal liability resulting from nuclear accidents. The Agency awarded research contracts to and concluded research agreements with institutes in many Member States. As the Agency's safety standards were formulated, they became the basis for regulations, manuals and codes of practice which eventually covered many aspects of nuclear technology and reflected its rapid evolution.

12/ See STI/PUB/40 and GC(IV)/RES/74

13/ Safety Series No. 9.

48. The Agency began to investigate the most effective means of providing international aid in the event of radiation accidents, as it was considered that the Agency could play a useful role in facilitating and co-ordinating the provision of assistance at the international level. Arrangements for the provision of assistance were subsequently developed and have been continually refined. In 1963 the Nordic Mutual Emergency Assistance Agreement in Connection with Radiation Accidents was signed by the Governments of Denmark, Finland, Norway and Sweden and by the Agency. In 1965 the Agency and WHO held a symposium on personnel dosimetry for accidental high-level exposure to external and internal radiation.

49. The second United Nations International Conference on the Peaceful Uses of Atomic Energy, in 1958, and the fourth regular session of the Agency's General Conference, in 1960, revealed the growing trend towards nuclear power. This led to strengthening of the Agency's activities in the area of reactor safety. The early 1960s saw the first international symposium on safety sponsored by the Agency and meetings on reactor safety evaluation techniques and the safety of research reactors. As nuclear power programmes rapidly increased, a symposium in 1963 on the siting of nuclear power plants signalled their growing impact on the Agency's safety activities.

50. With the rapid growth of nuclear power plant orders in the 1960s, attention focussed on the protection of the general public and the environment. There was growing public concern about the impact of nuclear energy on the environment, and this was reflected in the Agency's programme. In 1971 the Division concerned was reorganized and named "Division of Nuclear Safety and Environmental Protection" in order to reflect the new emphasis on these areas.

51. The Agency has co-operated actively with UNEP in its work on the environmental impacts of the production and use of energy. The number of requests for assistance in nuclear safety matters and the number of nuclear power projects to be reviewed from the safety point of view increased rapidly in the 1970s. This necessitated an urgent reappraisal of Member States' needs and of the Agency's corresponding programme. The

Agency therefore started a programme for the preparation of a comprehensive set of internationally accepted safety standards and guides for nuclear power plants - the NUSS programme, which covered five areas: governmental organization, siting, design, operation, and quality assurance. By 1982 the code of practice for each of these five areas and also 33 safety guides had been published.

52. The Three Mile Island (TMI) accident in 1979 led to a world-wide reassessment of nuclear safety activities. The Agency expanded its programme and in 1981 created a "Division of Nuclear Safety" concerned solely with the safe utilization of nuclear energy. Although it was determined, after the TMI accident, that there was no need for a drastic change in safety requirements or technology for nuclear power plants, it was clear that the lessons learned from that accident would have to be reflected in future activities; operational safety, including the so-called man/machine interface, and the need to understand the limits of human ability to cope with an increasingly complex environment would have to be major considerations in future planning.

53. Following the TMI accident, there was also a expansion of activities in the area of emergency planning and preparedness. The Agency prepared new publications giving technical guidance and sponsored training programmes and special assistance missions. Other new safety activities included the setting up of a system for reporting abnormal events, the promotion of an interchange of information on safety research, and the use of computer codes to help Member States solve safety problems.

54. The Agency also responded to the growing controversy over nuclear power by undertaking analyses of public opinion in various areas. This work included studies of the risks and benefits of nuclear power and the identification areas of public concern so that societal values could be taken into account in making safety decisions. The trade-off between protecting against low-probability, high-consequence risks and high-probability, low-consequence risks was also analysed.

55. During the 25-year period covered by this review, the Agency's nuclear safety activities expanded and changed as nuclear power grew in importance and complexity.

b) Waste Management

56. The Agency has been working in the field of radioactive waste management since its inception, though over the years the emphasis of the various components of the waste management programme has varied according to the development of nuclear technology.

57. In the initial period the Agency's activities were directed mainly towards the evaluation of existing practices and regulations and the preparation of health and safety standards as a basis for promoting harmonization of the legislation of Member States. One of the first activities was to assist Member States in controlling the discharge of radioactive materials into the sea. As early as November 1959 a joint Agency/UNESCO/FAO conference on the disposal of radioactive wastes into the sea and into geological structures was held in Monaco; it provided the first international forum for discussions between oceanographers, geologists and nuclear experts. In its work on radioactive waste disposal, including the collection and examination of information on disposal methods developed by advanced countries, a major consideration from the beginning was how these methods might best be adapted to the needs of the developing countries. Training courses were conducted, and several research contracts were awarded to institutes in developing countries for work concerned with the analysis of radioactive contaminants of the biosphere or with methods for the safe disposal of radioactive waste into the sea, fresh water or the ground. During this period the sources of radioactive wastes were mainly laboratories and research reactors.

58. In the expansion phase of the waste management programme, emphasis shifted to dealing with low-level wastes (LLW), intermediate-level wastes (ILW) and high-level wastes (HLW) from the entire nuclear fuel cycle; this was in line with the rapid growth of nuclear power as a major source of energy. Included in the programme was the management of wastes from the decommissioning of nuclear facilities.

59. A further impetus was provided by the United Nations Conference on the Human Environment held in Stockholm in 1972, following which the Agency decided that an urgent task in which it should play a leading role, in close collaboration with other international organizations, was the elaboration of safety standards concerning the dispersion into the environment of radioactive wastes resulting from the peaceful uses of nuclear energy. Moreover, the London Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter designated the Agency as the competent technical body to lay down the definition of wastes unsuitable for dumping and provide recommendations which must be observed by national authorities while dumping wastes which fall outside the prohibited category.

60. By the end of the period, the technology was available for the treatment, conditioning and storage of essentially all of the hazardous radioactive wastes from the nuclear fuel cycle, although the development of new, improved treatment methods is continuing.

61. The question of radioactive waste management is still, however, a major issue throughout the world and will perhaps remain so for some time into the future, as the further growth of nuclear power and its public acceptance depend very much on the provision of evidence that radioactive wastes can be managed and disposed of safely. The present efforts concern long-term waste disposal and the development of an internationally accepted set of guidelines and supporting technical documents on various options for underground disposal. Also, consideration is being given to the regional and world-wide impact of radionuclide releases.

C) Safeguards

62. The Agency's first efforts with regard to safeguards included the development of procedures in connection with the assistance programmes of certain Member States, the application of safeguards at the request of Member States and the development of internal safeguards measures for its own operations, including the provision of assistance to Member States. The first supply operation completed by the Agency involved the transfer of three tons of natural uranium to a Member State; this provided the first occasion for the Agency to prepare an official programme of safeguards. A set of general principles and regulations for the application of safeguards was provisionally approved by the Board, and in January 1961 the first system - known as the "Agency's Safeguards System (1961)" - was approved. In the same year the Board authorized the Director General to use three members of the Secretariat as safeguards inspectors.

63. This safeguards system related only to research, test and power reactors with a thermal output of less than 100 MW, to the source and special fissionable material used and produced in these reactors and to small research and development facilities. The first inspection in which the procedures developed by the Agency were used was performed in January 1962.

64. In 1965 the first major step was taken towards developing the Agency's safeguards systematically: a new safeguards system was adopted in place of the earlier one. The new system was subsequently extended through four stages to include reactor facilities of more than 100 MW(th), reprocessing plants and nuclear material in conversion plants and fabrication plants. This system, documented in INFCIRC/66/Rev.2, is still applied in safeguards agreements concluded with a number of countries.

65. By the end of the first decade after the founding of the Agency, the Board had approved a total of 34 safeguards agreements involving reactors in 27 States.

66. On 14 July 1967 the Treaty for the Prohibition of Nuclear Weapons in Latin America (the Tlatelolco Treaty) was approved by 21 States; it required, inter alia, the application of Agency safeguards to all atomic energy activities in the States party to the Treaty. The Treaty on the Non-Proliferation of Nuclear Weapons (NPT) came into force on 5 March 1970. It required the non-nuclear-weapon States party to the Treaty to conclude agreements with the Agency to meet the safeguards requirements of its Article III.

67. With the entry into force of NPT, the Board established a committee - in which all Member States were invited to participate - to advise on the Agency's responsibilities in relation to NPT and in particular on the content of the agreements required in connection with it. By March 1971 the committee had completed its work, and subsequently the Director General was requested by the Board to use the committee's recommendations, which were entitled "The structure and content of agreements between the Agency and States required in connection with the Treaty on the Non-Proliferation of Nuclear Weapons" [INFCIRC/153(Corrected)]. Both the Tlatelolco Treaty and NPT added significantly to the Agency's safeguards responsibilities.

68. It was agreed that the costs which the Agency incurred in applying safeguards in Member States should continue to be met from its Regular Budget, but that the method of assessing Member States for contributions to the Regular Budget should be adjusted so as to limit the share of safeguards costs borne by Member States having low per capita net national products. With the resulting method of assessment, developing Member States have had to pay a far smaller fraction of the costs of safeguards than they would have had to if no adjustment had been made.

69. Up to the time when NPT safeguards agreements first came into force, there were some 156 facilities under Agency safeguards. By mid-1973 there were 396 facilities under safeguards, and of those 167 were covered by agreements concluded in connection with NPT. In States party both to the Tlatelolco Treaty and to NPT, safeguards were applied under a single set of comprehensive arrangements which satisfied the requirements of both Treaties. The end of the calendar year 1982 saw 844 nuclear installations under safeguards;[14/] 754 of them were in States party to NPT.

70. During the past few years, the Agency's safeguards system was frequently the subject of public and political discussion and comment, sometimes in the context of debates on wider issues. It was evident from some of the comments made that there were still misconceptions about the purpose and scope of Agency safeguards and, in particular, about what they can and cannot achieve. Increased attention was therefore given to explaining and clarifying the Agency's safeguarding role and responsibilities in terms that are intelligible to the interested layman as well as to the safeguards specialist.

71. Increased attention was also given to measures which might increase the efficiency and effectiveness of safeguards. In 1980 the Agency established its first safeguards field office, in Canada. Also, arrangements were made with Japan for the assignment, on a long-term basis, of inspectors to that country.

D) Radioisotope and Radiation Applications

a) Food and Agriculture

72. Teams were formed in the late 1950s to consider appropriate applications of isotopes in the developing countries, and - inevitably - agricultural applications represented a substantial number of these. Several preliminary assistance missions were dispatched during this period, with the result that by the early 1960s the number of requests

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14/ Of these, 440 were facilities and 404 were "other locations".

for assistance in agriculture had increased substantially. It was at this time that the Agency's activities in soil fertility, plant nutrition, insect pest control, plant breeding and food irradiation were initiated.

73. By the early 1960s a number of fellows were being trained each year, experts in agricultural uses of radioisotopes and radiation were serving in several countries, scientific meetings were being held on the subjects mentioned in the preceding paragraph, and international and regional training courses were being organized. This was being done in close co-operation with FAO and NEA/OECD.[15/]

74. By the end of the first 5-year period work had commenced in the field of animal sciences, the first of the co-ordinated programmes of research had been initiated, and work had commenced on the first large-scale technical assistance project (relating to the development of a national institute of agriculture in a Member State). In collaboration with FAO and WHO work was being done on radiation-attenuated vaccines against certain animal diseases. Initial work on food irradiation was also being carried out.

75. Following the creation of the Joint FAO/IAEA Division of Atomic Energy in Food and Agriculture, in 1964, arrangements were made for more intensive collaboration with both WHO and FAO on food processing and for collaboration with UNSCEAR concerning the extent of food contamination from radioactivity in the environment and with the Austrian Atomic Energy Society and NEA/OECD on an international programme on the irradiation of fruit and fruit juices.

76. The research contract programme assumed increasing importance in relation to isotope and radiation applications in food and agriculture. Coordinated programmes of research were organized on

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15/ See GC(II)/RES/29

selected topics of relevance to developing countries as determined by consultants and by experience gained within the Secretariat. The work on soils gradually came to encompass the behaviour of plant nutrients in various types of soil and water-use efficiency. Likewise, plant nutrient uptake studies were systematically extended to cover a number of different crop plant types and both nitrogen and phosphorus fertilizers.

77. Work on the sterile-insect technique included ecological studies, the development of rearing methods, the determination of sterilization doses and field release trials for the olive fly, the Mediterranean fruit fly (medfly), the tsetse fly and selected lepidoptera of significance in relation to crop damage.

78. Work on pesticide chemicals was conducted to determine terminal residues in food, agricultural products and the environment, as a basis for the development of appropriate guidelines for safe and effective use, with particular emphasis on applications to commodities moving in international commerce.

79. Animal studies involving radioisotopes were gradually extended to include studies on nutrition, reproduction and diseases, primarily with regard to ruminants but also with regard to certain other species.

80. Besides the international programme of food and fruit juice irradiation and a international food irradiation project involving 22 countries, the Agency's activities concerning food preservation included co-ordinated research on such matters as wholesomeness, cost-effectiveness and extending the shelf-life of a variety of fruits, vegetables and fresh fish.

81. Considerable effort was made initially to explore the possibility of disinfesting cereals by irradiation, and much useful information was obtained. During the second half of the period, the emphasis shifted to demonstrating the wholesomeness of irradiated food and the technological feasibility of the irradiation process for disinfesting dried fish and fruits and eliminating pathogens in food.

82. In plant breeding, beneficial mutants were systematically sought through co-ordinated programmes of research and a world-wide computerized record system was established. By the late 1970s considerable work had been carried out, under an Agency/FAO/WHO/ILO/UNIDO/IUPAC programme, on the reliability of analyses of trace compounds in biological materials of interest to each of these organizations. Several co-ordinated programmes - on, inter alia, food irradiation and plant breeding for higher protein contents - were organized on the basis of direct assistance, involving both technical expertise and financing, by one or more industrialized Member States. Laboratory work progressed to the point where the problem of mass-rearing the medfly was essentially solved, and significant progress was made in relation to rearing techniques for the tsetse fly.

83. By this stage some 200 laboratories and other institutes in Member States were involved in Agency co-ordinated research programmes, more than 100 crop varieties had resulted from the use of radiation-induced mutations and some 60 commercial variants of ornamental plants had been developed. A service for mutation induction and for grain protein analysis permitted Member States without sufficient resources or scientific expertise to participate in mutation breeding activities. A submission had been made to the Codex Alimentarius concerning approval for the food irradiation process. Lastly, the number of technical assistance projects in agriculture had increased to more than 50.

84. During the most recent 5-year period one of the major events in respect of agriculture was the adoption by the Codex Alimentarius of the FAO/WHO/Agency recommendations on food irradiation. By the end of the 1970s at least 28 irradiated foods had received public health clearance in 20 countries, and the 22-country international food irradiation project had been completed. A large irradiation facility became available in a Member State at that time, as a result of which more than 90 scientists from developing countries have been trained in food irradiation technology since 1979.

85. The Agency provided advice and technical assistance aimed at controlling the medfly in one Member State. The project in question was a good example of rapid technology transfer in response to a specific problem of considerable economic importance.

86. By the end of the period more than 300 laboratories in Member States were participating in more than 25 co-ordinated programmes of research.

b) Life Sciences

i) Medicine

87. The first use of radioisotopes and radiation techniques in developing countries has often been in medicine. Close and effective collaboration with WHO was established from the beginning.[16/] Medical specialists took part in the early missions to developing countries, and a further important initial activity was a survey - conducted in co-operation with WHO - of large radiation sources used in therapy. The initial area of concentration was the use of isotope techniques in relation to parasitic diseases in tropical countries.

88. The first International Directory of Radioisotope Teletherapy Equipment was published before the end of the 1950s, and by the early 1960s direct assistance was being provided to hospitals and medical research institutes in the standardization and calibration of thyroid radioiodine uptake measurements. Research contracts were awarded largely for work on tropical diseases.

16/ See GC(II)/RES/29.

89. By that time the Agency was also paying substantial attention to the subject of whole-body counting and was establishing its own counter in Vienna, initially for research purposes.

90. Substantial training was provided for medical technicians and doctors (and also for agricultural specialists) through the use of two mobile radioisotope laboratories, and under the technical assistance programme a substantial number of fellows were being trained each year by the end of the 1950s.

91. By the end of the first 5-year period a programme on calcium-47 had been successfully concluded, the Agency's whole-body counter had been established, the Agency and WHO had jointly defined appropriate subjects for research in tropical medicine, and some 60 hospital isotope laboratories had been visited in a number of developing Member States in connection with thyroid radioiodine uptake measurements. Also, physics data had begun to be published for the guidance of radiotherapists and hospital physicists.

92. As the result of the work carried out jointly by WHO and the Agency, and by many other bodies, nuclear medicine was beginning to be recognized as a medical speciality in the early 1960s, and the Agency's programme of support for the development of medical radioisotope laboratories had developed substantially. The programme on the calibration of thyroid uptake measurements, involving some 100 laboratories in the hospitals visited in various Member States, was completed in the mid-1960s. As a result, a standard collimator was designed and built by the Agency's own laboratory and the blue-prints made freely available. By this time there were more than 1600 items of radiocobalt and other high-energy equipment in more than 50 countries. Also, about 100 whole-body counters were being used and the Agency was continuing to receive requests for advice on their construction and use.

93. By this time a programme had been initiated on the irradiation of pharmaceuticals for sterilization purposes. In one 3-year period in the mid-1960s more than 1000 requests from 17 Member States were

received for teletherapy and bracheo-therapy radiation data. Interest also began to develop more strongly in the use of radiation to sterilize materials such as biological tissues. By the late 1960s the Agency had compiled a register of radioisotope teletherapy installations and of other high-energy equipment used in therapy throughout the world, and an international code of practice for the sterilization of biomedical products had been formulated.

94. The 1970s witnessed a shift in disease research support towards the development of new or improved isotope and radiation techniques. In the second half of the decade substantial attention was being devoted also to the cost-effectiveness of certain medical techniques in developing countries. This led to concern about the problem of maintaining nuclear medicine instruments and to work on constructing and testing prototypes of well-type scintillation counters for the specific requirements of developing countries, particularly those in tropical and sub-tropical zones.

95. Surveys of equipment maintenance practices at some 90 laboratories in 8 south-east Asian countries and at some 100 laboratories in 10 Latin American countries were carried out during the last 5-year period.

96. Other activities of importance included efforts to improve the quality of radioimmunoassays and other in-vitro assays. They included the preparation of reference materials for quality control and joint training activities by WHO and the Agency. Quality control was also emphasized in relation to in-vivo nuclear medicine techniques.

ii) Radiation Biology and Dosimetry

97. Almost from the outset, the Agency supported fundamental research in radiation biology, which it recognized as being necessary for a more complete understanding of the interaction of ionizing radiation with living matter. In doing so, it co-operated closely with organizations such as WHO, UNESCO, UNSCEAR, ICRP and ICRU.

98. By the end of the initial period, the Agency was supporting research projects in 14 Member States - on radiation damage at the cellular and sub-cellular level, on means of modifying resistance to radiation, and on the preservation of drugs, bio-synthetic products and food by irradiation. Training in radiation biology techniques was initiated, together with other technical co-operation activities. Also, attention was focussed on the measurement of radiation, with a symposium on neutron detection and dosimetry.

99. By the mid-1960s, the biological effects of neutron irradiation, the modification of radiosensitivity, and the toxic effects of ingested radionuclides were prominent topics in the Agency's programme. The research being done in these areas, some of which was supported through Agency research contracts, was important for the studies being carried out on food irradiation and the radiation sterilization of medical supplies. Close co-operation with WHO and other organizations continued.

100. At the end of the decade, increasing emphasis was being placed on practical applications such as the sterilization of tissue transplants and the study of immunological processes and cell proliferation. Some 50 research contracts were active, and research support was being complemented by scientific meetings and technical co-operation activities.

101. During the first half of the 1970s, increased attention was paid to the study of vaccines against parasitic diseases of importance for public health, particularly in tropical and sub-tropical zones, and to genetic and somatic effects of radiation in man. In the latter half of the decade, work started on the neutron activation analysis of pollutants in human hair and on the radiation treatment of sewage. A regional programme on radiation sterilization practices was initiated in Asia.

102. Despite early recognition of the importance of dosimetry, it was only in the second half of the 1960s that the Agency's programme was strengthened through the introduction of activities relating to the

measurement of ionizing radiation used for medical and biological purposes - particularly radiation therapy. These activities included a postal dose intercomparison service which, by the end of the decade, encompassed more than 100 hospitals and clinics in more than 30 Member States. Also, research on dosimetry was initiated through research contracts.

103. By the mid-1970s the postal dose intercomparison service, being operated in collaboration with WHO, had substantially reduced the deviations in measurements against Agency standards. Also, a start had been made - again in collaboration with WHO - on establishing Secondary Standard Dosimetry Laboratories (SSDLs) in developing and other countries. In the latter half of the decade a trial dose intercomparison was carried out for orthovoltage X-rays.

104. Through its research contract programme, the Agency supported in particular studies of the effects of radiation on man and health-related environmental research. Efforts started on developing a chromosome-based system for ascertaining hazards from low radiation doses and on methods of using human hair as an indicator in the monitoring of inorganic pollutants in man. Also, the Agency supported research activities related to cancer treatment and to the use of radiation genetics for improving industrial micro-organisms.

105. By the end of the period over 45 SSDLs had been designated, of which more than a half were in operation. The Dosimetry Laboratory at Seibersdorf had come into full operation and assumed its function as central laboratory of the SSDL network. An intercomparison exercise for cobalt-60 irradiators was conducted with the participation of 20 SSDLs.

c) Physical Sciences

i) Hydrology

106. Initially, isotope applications in hydrology developed somewhat more slowly than those in agriculture and medicine. The early years were devoted largely to a review of their potential and to planning.

107. By the early 1960s a worldwide survey had been initiated to determine the concentration of hydrogen and oxygen isotopes in natural waters in order to obtain important baseline data; with the help of WMO a number of sampling stations were established. By that time also the Agency itself had developed sufficient capability to carry out its own determinations for these isotopes. Isotope-aided studies were initiated in several arid and semi-arid regions. The Agency promoted a major review of tritium counting through a symposium on that technique as used in the physical and biological sciences.

108. At the end of the first 5-year period, routine analyses were being performed of oxygen and hydrogen samples taken from river waters and detailed plans were being made for a comprehensive study of silt and sand movement in a major river basin.

109. By the mid-1960s the Agency had begun to take part in the International Hydrological Decade. This involved the development and use of isotope techniques for determining such parameters as flow velocity and direction, recharge rates, and underground connections of aquafers. In the course of these activities, close co-operation developed with national and regional groups. The Agency's programme began to include the analysis of water samples taken from major rivers and from the oceans and of water vapour samples collected at various altitudes.

110. Studies involving determination of deuterium, tritium, oxygen-18 and other isotopes were systematically undertaken in a number of countries in Europe, the Middle East, Africa, Latin America and Asia.

111. The results of the Agency's determinations of deuterium, tritium and oxygen-18, which involve more than 150 stations, began to be published in 1968. Guidebooks and special monographs on isotope hydrology were published, and the Agency started to award research contracts designed to improve isotope hydrology techniques or to adapt them to specific situations.

112. By the mid-1970s, the Agency's Laboratory was supplying reference samples for tritium and stable isotopes to laboratories in Member States and intercomparisons of low-level tritium measurements were being carried out; three such exercises were undertaken, involving more than 40 laboratories in 20 Member States. By the late 1970s, Agency/WMO activities were being merged as appropriate in order to integrate them with those being conducted through the UNEP Global Environmental Monitoring System (GEMS).

113. Close co-operation with other United Nations organizations continued; for instance, in 1980 the Agency assisted 20 Member States in the assessment of their water resources under sub-contractual arrangements with such organizations.

ii) Industry

114. The Agency recognized at the outset that industrial applications of isotopes and radiation had considerable potential in developing as well as in industrialized countries. However, some time passed before it was able to recruit the necessary specialists and make a comprehensive survey of the field.

115. An early search of the literature revealed some 900 applications in 40 different branches of industry.

116. By the end of the initial 5-year period a systematic survey of industrial applications had been completed and a major conference had been held (with the co-operation of UNESCO) on the use of radioisotopes in the physical sciences and industry. Also, planning was well advanced for a conference on the use of large radiation sources in industry.

117. Early in the 1960s, an international survey of the economic benefits of using isotope technology in industry indicated annual net world savings of the order of $ 300-400 million. Most of these savings resulted from process control, with nearly 9000 process control instruments in use at that time in some 25 countries.

118. Following a technical mission undertaken at the request of the RCA countries, several demonstration projects involving industrial applications of isotopes and radiation were worked out in consultation with these countries and with UNDP.

119. An installation for paper processing control has been set up and demonstrated in one Member State and work is continuing on process control equipment for a steel mill in another.

120. The Agency is supporting research in a number of fields, including the use of particle accelerators and the development of new radiopharmaceuticals. Also, substantial work has been done in reviewing technetium-99 generators.

iii) Physics and Chemistry

121. From the outset, it was evident that attention to the basic physical sciences was necessary in support of the Agency's activities relating to isotope techniques and reactor technology. However, it took some time to build up the requisite competence, and the programme in physics during the initial period was limited almost entirely to reactor physics; accordingly, it was conducted from within the Reactor Division. Activities in chemistry were initiated through an international comparison of analytical techniques. Also, at this time the ground was laid for the subsequent development of nuclear data activities.

122. Physics activities began to expand in the early 1960s, through work on solid-state physics and the establishment of a nuclear data group. It was at this time also that interest in supporting more fundamental areas of enquiry led to the establishment of the International Centre for Theoretical Physics in Trieste.

123. Interest in fusion also dates from this time, with the publication of the first issue of the "Nuclear Fusion" in 1960. By the mid-1960s, fusion had become a permanent - though as yet not major - component of the physics programme. The work in nuclear and solid-state physics was centred on the exchange of information on fission, neutron physics and selected nuclear methods. Modest support was by that time being given,through research contracts, to work in nuclear physics, radiation damage studies and work in solid-state physics.

124. By the end of the decade, the emphasis in physics had shifted to projects that could lead to practical applications, provide the scientific basis for a long-term development of technology or help developing countries to do significant work in nuclear physics research or training. Activities in chemistry during the 1960s consisted mainly of the exchange and assessment of data on the thermodynamics of nuclear materials and work relating to the use of research reactors and large radiation sources in chemistry research and in industry.

125. Following the establishment of the International Fusion Research Council, at the beginning of the 1970s, interest began to focus more sharply on fusion. By the middle of the decade the possibility of international co-operation in the construction of a fusion device was being discussed.

126. During the first half of the 1970s, the emphasis in chemistry began to be placed on radio-pharmaceuticals, labelled compound production and control, and analytical methods relating to the fuel cycle. Then it began to shift towards isotope and radiation techniques of importance to industry.

127. During the past 5 years, the "zero phase" and "phase I" of the INTOR study were completed and work started on "phase II". Physics research was supported in areas considered to be of major relevance to developing countries and further attention was given to increasing the utilization of research reactors.

128. Activities in chemistry continued to be concerned largely with applications of tracers and radiation technology in industry and with the production and quality control of reactor- and accelerator-produced radionuclides and radiopharmaceuticals.

iv) Monaco

129. A joint research programme on the behaviour of radionuclides in the marine environment started in the early 1960s, following the conclusion of a 3-year agreement between the Agency, the Government of the Principality of Monaco and the Institut Oceanographique (Paris). The initial studies focussed on the movement of radionuclides, their concentration in marine organisms and their effect on such organisms; at the same time, similar research was being supported in several Member States. Close contact was maintained from the outset with UNESCO's Intergovernmental Oceanographic Commission and with FAO.

130. By the end of the first 5 years, the Monaco Laboratory's programme had been established and was becoming important in relation to other oceanographic studies being conducted through the United Nations system and in several Member States, particularly the Mediterranean countries.

131. Following a review in the mid-1960s, which indicated that the on-going activities should continue on a broader basis, the Laboratory began to concentrate on developing and assessing analytical methods for studying the chemistry of trace elements in the marine environment. With time, as space and resources permitted, small numbers of

individuals were accepted for training at the Laboratory. Late in the 1960s the Laboratory participated in a co-ordinated research programme that ultimately involved institutes in 16 countries.

132. An important activity of the Laboratory during the 1970s was an intercomparison, involving more than 50 laboratories in 26 countries, of measurements of standardized contaminated sea water samples.

133. By this time the main emphasis was on standardizing and calibrating the analytical methods used by national laboratories in studies concerning the effects of radio-activity on the sea and on marine life. During the early 1970s the Laboratory began to take an active part in the work of IMCO and GESAMP (Group of Experts on the Scientific Aspects of Marine Pollution). The Laboratory became a focal point for the development of recommendations in connection with the Agency's responsibilities under the London Dumping Convention.

134. By the mid-1970s the Laboratory's measurement capability included alpha spectrometry and atomic absorption spectrometry for trace-metal determinations and high-resolution gamma spectrometry and gas chromatography for the analysis of pesticide residues and for measuring dissolved organic carbon in sea water. Subsequently the Laboratory acquired a capability for the analysis of heavy metals and chlorinated hydrocarbons.

135. Intercalibration activities, which eventually involved more than 100 laboratories in 27 Member States, dealt, inter alia, with measurements of strontium-90, caesium-137, plutonium-239 and plutonium-240.

136. During this period, studies of non-radioactive pollution by non-radioactive substances such as heavy metals were carried out on a limited scale against reimbursement from UNESCO and UNEP.

137. Through UNEP's Mediterranean Action Plan and other activities the Laboratory became increasingly active in providing support for analytical work in various Mediterranean countries.

138. In recent years the Laboratory has continued to do substantial work on transuranium elements and - in collaboration with UNEP - to serve countries of the Mediterranean basin in a number of important ways.

139. Most recently, work relating to the disposal of radioactive wastes in the deep oceans has been initiated and given high priority, and it is considered that this work will continue to receive high priority. The Laboratory has increased its efforts to provide scientific and technical training in radiochemical and radiobiological procedures. By the end of the period the Laboratory had further strengthened its contacts with other bodies and was receiving financial support for selected activities from UNESCO's Intergovernmental Oceanographic Commission, UNEP's Mediterranean Action Plan, the Kuwait Action Plan, and the United States National Science Foundation.

E) International Centre for Theoretical Physics

140. The activities of the International Centre for Theoretical Physics commenced in October 1964,[17/] with a 4-week seminar on theoretical plasma physics; this was followed by a seminar on high-energy and elementary particle physics. By the late 1960s the Centre had become firmly established with, a basic pattern of courses, scientific meetings and research; also, the Centre was awarding a number of fellowships, and the system of associateships and federated institutes had been initiated.

141. The period of joint operation with UNESCO began in 1970.

142. By the mid-1970s some 1000 scientists were visiting the centre annually. The main topics had become nuclear and particle physics, solid-state physics and applicable mathematics, and substantial

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17/ See GC(IV)/RES/76, GC(V)/RES/107, GC(VI)/RES/132, and GC(X)/RES/214.

research was being carried out at the Centre on these and other topics. In addition, work was being done in certain areas of biophysics, astrophysics and geophysics; later, the teaching of physics and solar energy conversion were taken into the programme.

143. As the Centre developed, therefore, the emphasis shifted gradually from a narrow concern with nuclear, elementary particle and plasma physics to a wide range of topics and the programme came to include a number of innovative courses in which participants explored the interface of certain related disciplines or the interface of physics with certain problem areas of relevance to modern society.

144. The most recent period has witnessed an intensification of the activities at the Centre, the initiation of courses in 2 developing countries, and the development of a programme designed to acquaint scientists from developing countries more directly with research in large laboratories. In addition to the core activities carried out previously, the Centre has stepped up its work relating to various forms of non-conventional energy and to applications of physics in areas of particular interest to developing countries such as monsoon dynamics and the geophysics of arid regions.

2. The Mechanisms

i) Technical Co-operation

145. Various mechanisms have been used at different times for assisting Member States in the Agency's fields of activity. These mechanisms evolved over time as separate but complementary entities and they are presented below as such. Nevertheless, with the steadily increasing needs of the developing Member States, most of the mechanisms, particularly advisory missions and regional co-operation, have become increasingly integrated with the Agency's technical co-operation activities. These latter have come to represent the principal mechanism for development aid in the areas of relevance to the Department of Research and Isotopes and the Department of Nuclear Energy and Safety.

146. Technical assistance and co-operation activities in their present form were not included in the Agency's initial programme or provided for in the structure of the Secretariat. As the Report of the Preparatory Commission noted, most proposed activities were intended to benefit developing countries in particular, and it was expected that several Divisions of the Secretariat would be heavily involved in these activities. The Division of Economic and Technical Assistance formed part of the Department of Technical Operations until 1963.

147. Training was given high priority in the early years;[18/] in the 1958 budget $ 250 000 were earmarked for a fellowship programme to be financed out of voluntary contributions to the General Fund. In the following year the programme was expanded to include the provision of experts and equipment, the latter intended primarily for demonstration purposes. After various interim arrangements, the Guiding Principles and General Operating Rules to Govern the Provision of Technical Assistance by the Agency were established in 1960,[19/] and are now in force as revised by the Board of Governors in 1979.[20/] The available resources - consisting of voluntary contributions and gifts in kind from Member States and EPTA [21/] and Special Fund resources - reached $2.5 million in 1960; growth was very slow, however, during the 1960s.

148. In order to assist Member States in introducing applications of radioisotopes and radiation the Agency fielded a number of so-called Preliminary Assistance Missions, following which Member States submitted proposals for technical assistance projects. Such projects usually involved setting up radioisotope laboratories with a modest amount of equipment and providing expert services. The Agency's fellowship programme provided opportunities for young scientists to undergo specialized training, and the Agency's records show that many of the early fellows have been serving in leading positions in their countries for some time.

18/ See GC(I)/RES/6.

19/ See GC(IV)/RES/65.

20/ See INFCIRC/267.

21/ United Nations Expanded Programme of Technical Assistance.

149. It was felt in the early 1960s that, if the Agency was to assist developing Member States on a scale commensurate with their needs, an organizational structure based on geographical areas would be required. In an attempt to improve the Agency's operational contacts with its Member States in Asia, most of which were recipients of technical assistance, the Director General appointed in 1963, on an experimental basis, a Regional Officer for Asia and the Far East, stationed in Bangkok. In July 1971, however, the Office was closed for economic reasons, and no similar regional office has been established since. In 1964, the Department of Technical Assistance was formed in order to improve the planning and implementation of technical assistance programmes. This reflected the conviction that technical co-operation needs and priorities can best be seen within the framework of the national development goals of recipient countries. Also, it implied that two professional groups within the Agency would co-operate in the provision of technical assistance - namely, Technical Officers in the Agency's technical Departments and Area Officers in the Department of Technical Assistance. This concept was considerably ahead of its time; in other United Nations organizations dealing with technical co-operation it was introduced only during the 1970s, and the International Civil Service Commission established a job classification standard for what it now called "Technical Co-operation Administrators" only in 1982. The 1964 re-organization in the Agency was essential for achieving more efficient, integrated programming at the country level.

150. By the end of the first 5-year period, technical assistance activities had found their place within the Agency's overall programme. Their content derived from the requests of developing Member States, where the emphasis continued to be on the introduction of radioisotope and radiation techniques for various purposes.

151. One of the Agency's most strongly emphasized initial aims was to provide Member States with fissionable material; to this end some 5170 kg of special fissionable material in the form of uranium-235 contained in enriched uranium were made available to the Agency by 3 industrialized Member States. In order to deal with such material, a Division of Technical Supplies had been created at the outset. This Division dealt also with the procurement of equipment for the technical assistance programme and the research contract programme. The latter programme eventually became the most important one of the Division, which was in 1963 attached as a Section to the new Department of Technical Assistance.

152. Although there was no great demand for fissionable material in the early years of the Agency's existence, fuel was provided for some research reactors and many small quantities of various kinds of fissionable material were provided for research purposes. An appropriate legal and administrative framework was developed for these transactions, and altogether 54 project agreements with 21 Member States were approved by the Board over the 25-year period.

153. The basic pattern and mode of operation for the Agency's technical co-operation activities has required only minor adjustments in order to permit continuing effective operation as these activities have gradually increased in scope and complexity.

ii) Research Contracts and Agreements

154. Though initially established to provide basic research support in connection with certain of the Agency's statutory functions, the research contract programme lent itself to the sponsorship of integrated research at a substantial number of institutes and in a considerable range of nuclear science and technology subjects. The programme thus came to be heavily oriented, at an early stage, towards radioisotope applications - especially those of relevance to developing countries.

155. Initially, the programme generally made provision for the support of projects for a period of some 3 years, beyond which it was considered that the institutes themselves would be able to ensure further funding. An important factor from the outset was the willingness of the Agency to provide smaller items of equipment and supplies, if requested to do so by the contractor, for a portion of the funds made available. Another important factor was the requirement that scientific reports be submitted at appropriate intervals so that research progress could be judged accurately. Towards the end of the initial period, use began to be made of the Chief Scientific Investigators involved in the research contract programme as a pool of specialists, and arrangements for occasional meetings were made.

156. The limited funds available for the support of research, combined with the international character of the Agency, provided strong impetus for the development of research programmes in which groups of institutes worked on well-defined themes usually chosen for their relevance to the needs of developing countries. In order to ensure proper co-ordination, meetings of representatives of the institutes were arranged at appropriate intervals. The time-span for most of these programmes was set at about 5 years. By the mid-1970s some three-quarters of all research expenditures were on co-ordinated programmes of research. The role of the Agency in supporting research thus became not just a catalytic one but also a co-ordinating one.

157. It was during this period that the use of the research agreement was developed. Such agreements were designed to provide for the participation of selected institutes in co-ordinated research programmes without reimbursement. However, provision was made in each case for inviting the Chief Scientific Investigator to any co-ordination meetings held. At the outset, the institutes participating in co-ordinated research programmes through research agreements were all located in industrialized countries. By the end of the period, however, many institutes from a number of developing countries also were participating in such programmes through research agreements.

158. Institutes in developing countries initially participated almost only in isotope research, but by the late 1970s such institutes were participating in every category of research supported by the Agency.

iii) Co-operation with other Organizations

159. As the Agency's activities developed in areas of relevance to other organizations in the United Nations family, contacts were strengthened with FAO, ICAO, ILO, IMO, UNESCO, WHO and WMO, with each of which the Agency had concluded a relationship agreement. In the case of FAO and UNESCO, co-operation was institutionalized through the establishment of the Joint FAO/IAEA Division of Atomic Energy in Food and Agriculture and the Agency/UNESCO agreement for the joint operation of the International Centre for Theoretical Physics. Relations with WHO and WMO became very close also because of shared programme interests. The relationship agreements concluded with various members of the United Nations family are shown on the following chart.

160. In 1963-64 the General Conference adopted resolutions on co-operation with the United Nations in matters of energy and power.[22/] It was felt that closer co-operation was necessary, in particular in comparative studies of the economics of conventional and nuclear power; co-operation with the World Bank was also envisaged. For various reasons no practical and systematic co-operation was created until only very recently, however, have several joint or well co-ordinated energy study projects with the World Bank been initiated.

22/ See GC(VI)/RES/128 and GC(VII)/RES/155.

ORGANIZATION	RELATIONSHIP AGREEMENT
UNESCO	October 1958
ILO	November 1958
WHO	May 1959
WMO	August 1959
ICAO	October 1959
FAO	November 1959
(FAO/IAEA Joint Division)	(September 1964)
IMCO	October 1961

161. Also, co-operation agreements were concluded with several intergovernmental organizations; they are shown below.

ORGANIZATION	CO-OPERATION AGREEMENT
NEA/OECD	September 1960
IANEC	December 1960
OAU	March 1969
OPANAL	October 1972
EURATOM/EC	December 1975
LEAGUE OF ARAB STATES	December 1971
CMEA	September 1975

iv) Regional Activities

162. Though various activities of the Agency, such as training courses, were of a regional character, the first truly regional programme was developed in the early 1970s by means of the Regional

Co-operative Agreement (RCA). The arrangements developed, which involved 11 Member States at the outset, provided not only for joint activities but also for continuing contact, at both the technical and the political level, between scientists and other representatives of the States concerned. Under RCA a number of co-ordinated research projects have been carried out, contacts between institutes in the region concerned have been strengthened and a basis has been laid for joint activities of a larger nature. During the latter part of the 1970s the programme was enhanced through the participation of 2 industrialized Member States located in the region concerned.

v) INIS

163. In the course of rapid technical development in the nuclear energy field there was an increasing need to co-ordinate relevant abstracting services. To this end the General Conference adopted resulutions in 1960 and 1963 which could be considered as the basis for the development of the International Nuclear Information System (INIS) 23/. This was the first international bibliographic information system with decentralized preparation of input to a common data base, centralized processing of the input, and distribution of a consolidated information file to all participants. The first output was produced in April 1970; it was of limited scope and based on input from a relatively small number of Member States. The size of the data base increased slowly over the next few years as Member States organized input centres and the Secretariat in Vienna worked out central processing procedures. By 1974 the system was fully developed and the data base was growing by more than 60 000 records annually. Abstracts were added to the output at the end of 1975, and on 1 January 1976 INIS became the sole internationally recognized abstracting and indexing service in nuclear science and technology.

23/ See GC(IV)/RES/78 and GC(VII)/RES/150.

164. The number of INIS participants has more than doubled since 1970, from 38 at the start to 82 at present, (68 Member States and 14 international organizations). Most industrialized countries have joined the system, as have a large number of developing countries. This computer-based system now processes between seventy and eighty thousand documents per year, and provides output products in the form of additions to the database on computer tape, the printed abstract journal INIS Atomindex and microfiche copies of literature not available through normal commercial channels.

vi) CAS

165. In June 1980 the Committee on Assurances of Supply (CAS) was established by the Board of Governors as an open-ended committee to consider and advise the Board on:

(i) ways and means in which supplies of nuclear material, equipment and technology and fuel cycle services can be assured on a more predictable and long-term basis in accordance with mutually acceptable considerations of non-proliferation;
and

(ii) the Agency's role and responsibilities in relation thereto.

166. CAS's sessions have been attended by representatives of 40 - 50 Agency Member States and by observers from up to four intergovernmental organizations.[24/]

167. CAS established three working groups - to consider

(i) "Principles of international co-operation in the field of nuclear energy in accordance with the mandate of the Committee on Assurances of Supply";

(ii) "Emergency and Bank-up Mechanisms"; and

(iii) "Revision Mechanisms".

24/ By the end of the period under review, CAS had held six sessions; in 1983 it held four further sessions

vii) Nuclear Data

168. In the late 1960s the Agency assumed responsibility for providing nuclear data services to Member States under an agreement with co-operating nuclear data centres. It established the International Nuclear Data Committee, which reviews and directs the nuclear data activities on the basis of the needs and priorities of advanced and developing Member States. A network of Liaison Officers, representing the nuclear science communities in developing Member States, was also established at that time.

169. By 1970, the Nuclear Data Section, in co-operation with three other nuclear data centres, had established a common format (EXFOR) for the exchange of nuclear data on magnetic tapes, initiated the systematic compilation and exchange of experimental neutron nuclear data, and begun to publish an international index to neutron data (CINDA). In response to requests from laboratories in developing Member States, experimental and evaluated nuclear data and the targets and samples needed for nuclear data measurements began to be distributed. To keep abreast of the expanding applications of nuclear data in many areas of science and technology, a programme of meetings to survey the need for all types of nuclear data was started, and the publication of a world request list for nuclear data (WRENDA) was initiated. As a result of these activities the scope of the nuclear data programme broadened to include photon and charged-particle-induced nuclear reaction data, and a network of centres and groups was formed for the systematic compilation, evaluation and publication of nuclear structure and decay data. Also, in response to a request by the International Fusion Research Council, a programme for the compilation, exchange and distribution of atomic data for fusion was initiated in 1977.

170. In the past five years, emphasis has been placed on the quality control of nuclear data files and associated computer codes and on the data requirements of growing technologies.

viii) Laboratory Services

171. The Agency's laboratories were established to provide laboratory support to various programmes and, of equal importance, to enable the Agency to engage directly in scientific activity whenever necessary.

172. Laboratory work started in the basement of the temporary Headquarters. By 1962, however, the Agency's Laboratory at Seibersdorf had become operational. The scope of activities gradually increased from the original calibration and environmental radioactivity measurements to include agricultural applications of isotopes, with work continuing at the temporary Headquarters on isotope hydrology, dosimetry and medical applications of isotopes. By the late 1960s the emphasis had shifted from support for the Agency's own programmes to more direct assistance to developing Member States. A considerable amount of support was provided through co-ordinated research programmes, with the Agency's Laboratory providing back-up services and advice to co-operating laboratories.

173. In 1975, an important addition was made to the capability of the Agency's Laboratory through the opening of the Safeguards Analytical Laboratory, which was established to perform analyses in support of the Agency's safeguards. With the move to the Agency's permanent Headquarters at the VIC, all laboratory activities except the isotope hydrology work (which is being done at the VIC) were consolidated at Seibersdorf.

3. Indicators of Programme Activity

174. A comprehensive analysis of programme impact, or even of total activity, is beyond the scope of this review. However, it is worth examining various primary indicators of activity for which data are available in the form of item counts or funds expended. The following charts give a rough picture of total activity over the period. For ease of presentation, and in order to smooth out certain of the annual

fluctuations, they are in the form of summary counts for five 5-year periods. It should be noted that comparisons can be made only horizontally, as the various vertical scales and the items counted differ as one moves up or down the page. In order to provide a very rough measure of "input", as well as "output", information is given on Regular Budget programme levels and on Professional staff man-years. As might be expected, the indicators for safeguards differ from those for other activities. All expenditure figures are for current dollars.

175. As will be seen, the number of meetings generally doubled or tripled between the second and the fifth 5-year period, except for meetings held in relation to reactor safety and radiation protection, which increased by a factor of about seven. A similar situation exists for publications, which nearly trebled in the field of safety between the second and the fifth period while for all other programmes the increase was only about 50%.

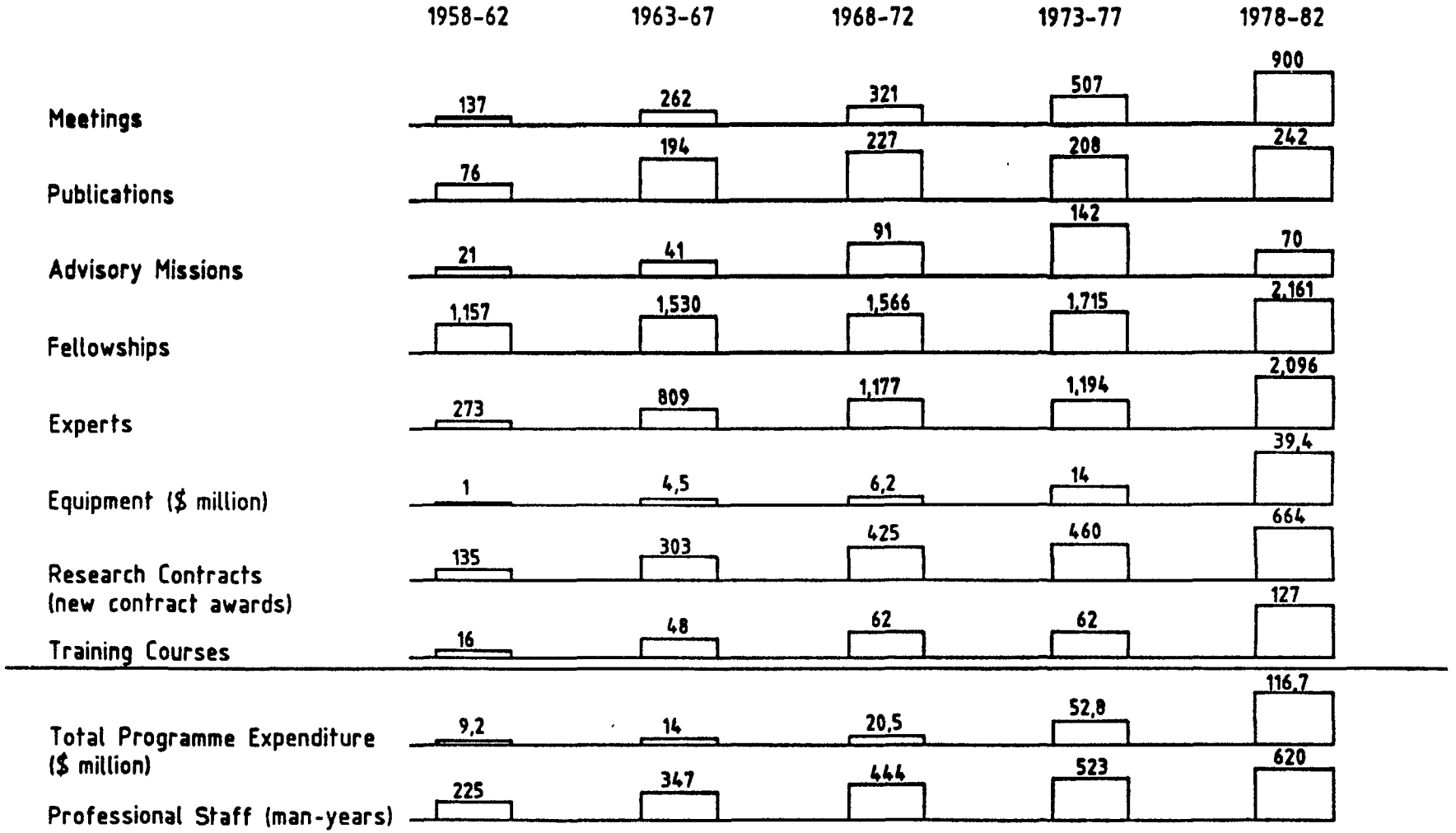
176. Great use of advisory missions was made in connection with nuclear power and safety-oriented activities during the intermediate three periods, whereas such missions have been used to a major extent in connection with isotope and radiation applications only during the past five to ten years. Fellowships, on the other hand, displayed a generally stable growth pattern over the full period, except for fellowships in connection with nuclear safety, which showed a higher growth factor in the most recent period.

177. The number of experts employed increased by a factor of about two and a half between the second and the fifth period, with all programmes except Life Sciences registering a substantial increase in the most recent period.

178. Perhaps the most striking feature is the increase in the amount expended for equipment. The figures at least doubled in all categories between the fourth and the fifth period, and overall they nearly trebled. Between the second and the last period, the increase was eight-fold.

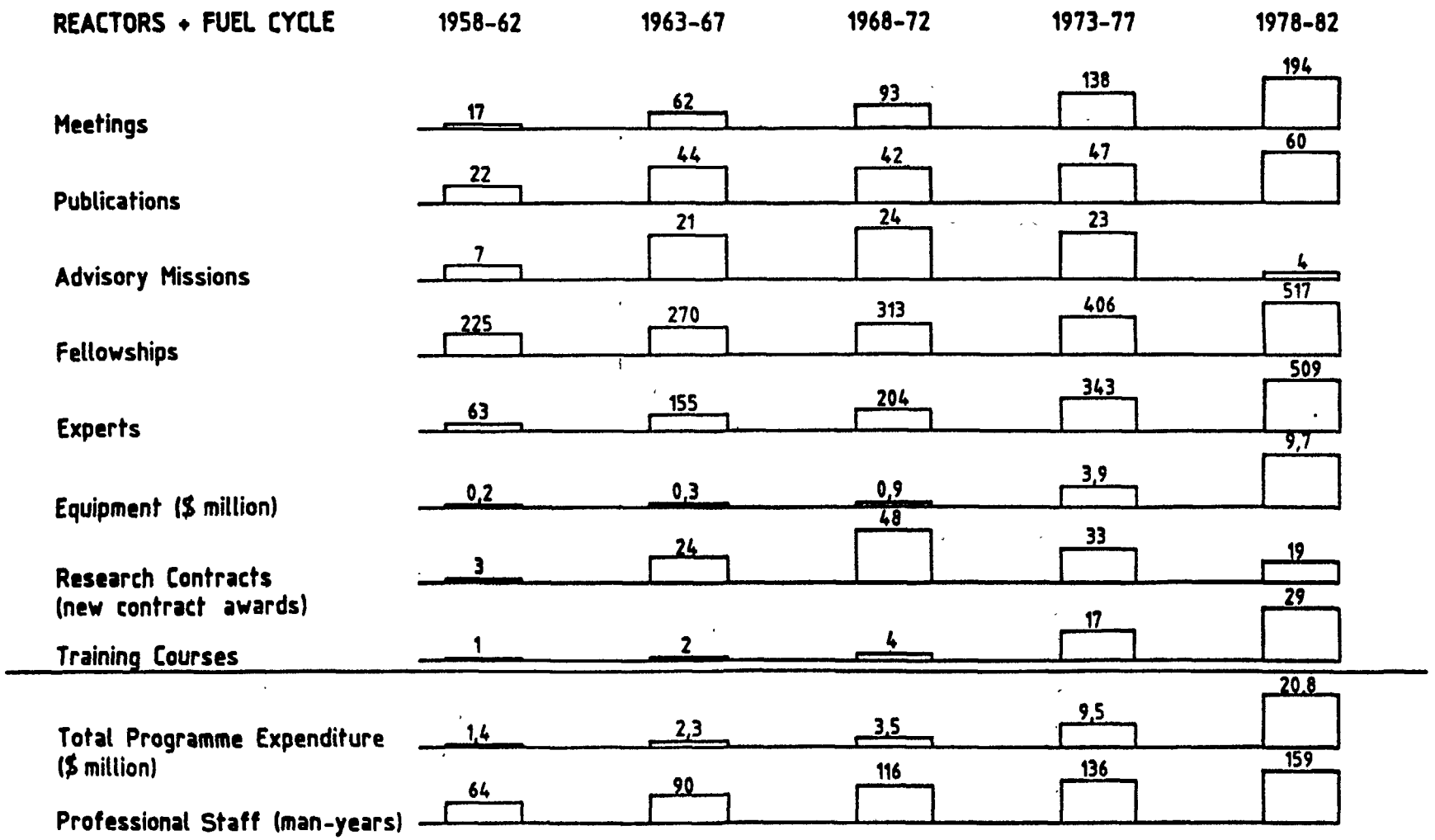
179. Training courses displayed a continuing upward trend for all programmes, more or less doubling between the fourth and the fifth period in all fields. The overall trend in Life Sciences, however, was rather flat. For research contracts a continuous increase was noted in most fields except reactor-oriented research, which has continued to decline over the past decade.

Indicators of Programme Activity - All subjects*

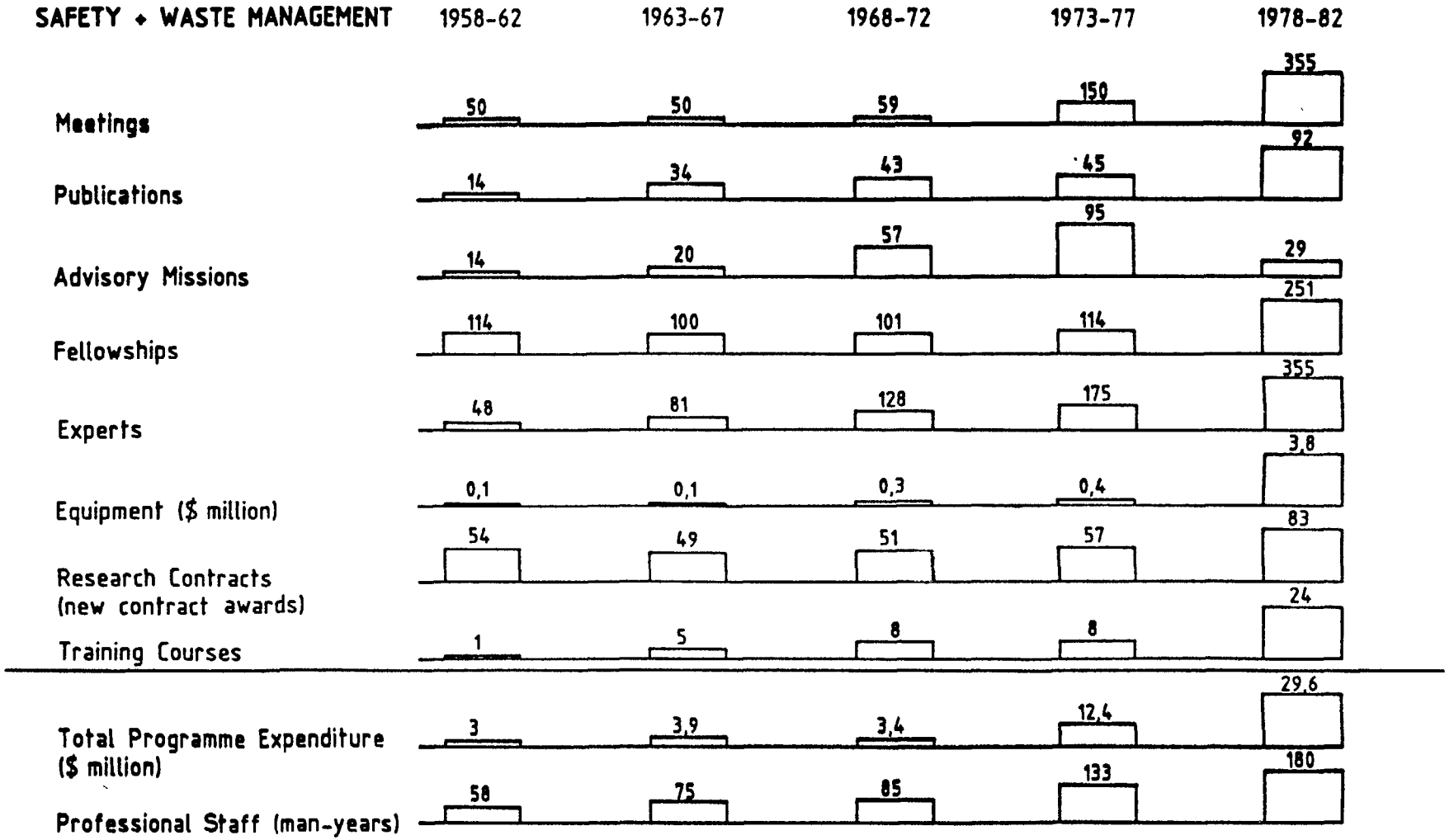


*Except Safeguards

Indicators of Programme Activity



Indicators of Programme Activity



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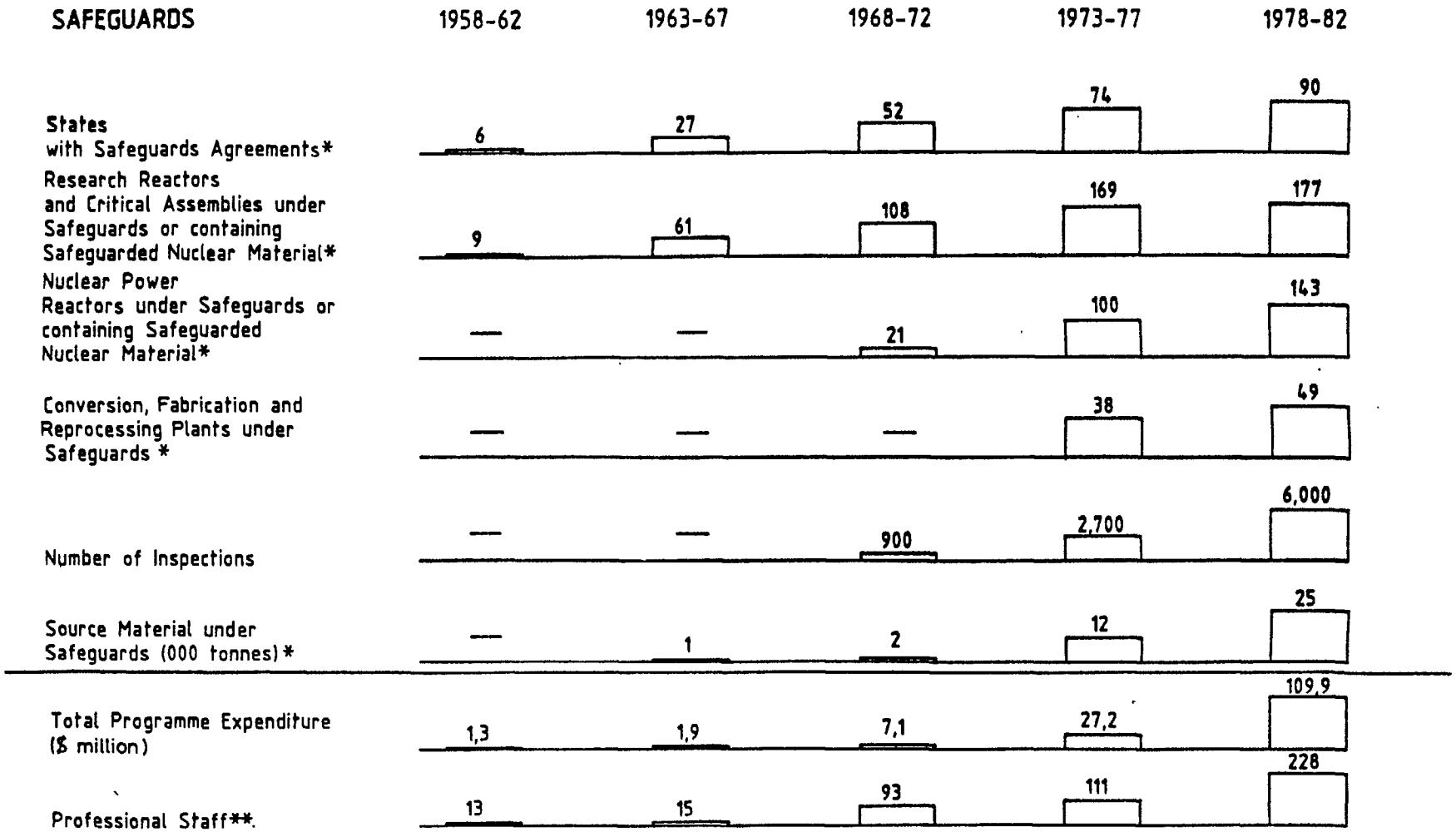
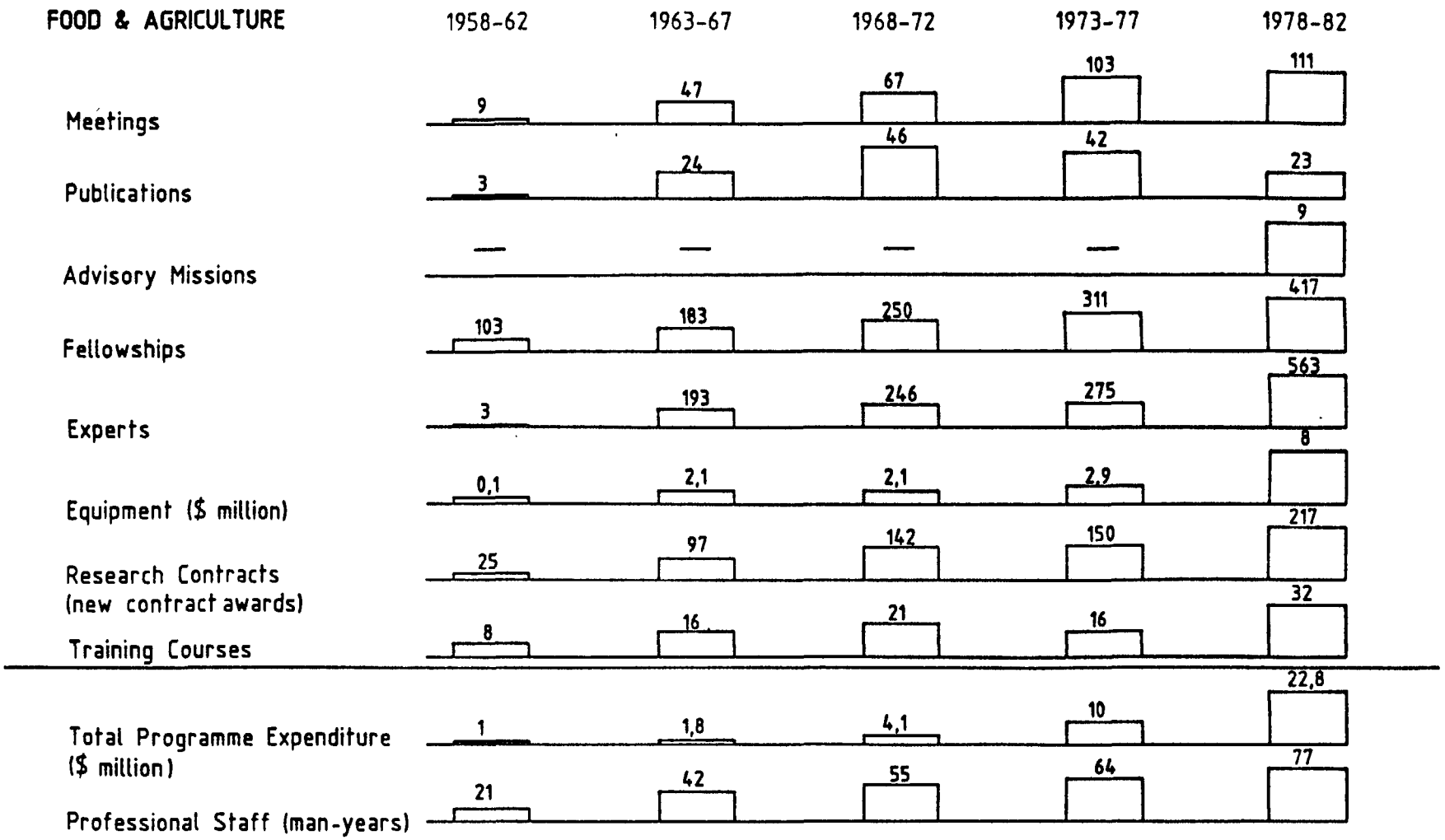


* Number at end of period.
** Budget figure for end of period.

Indicators of Programme Activity



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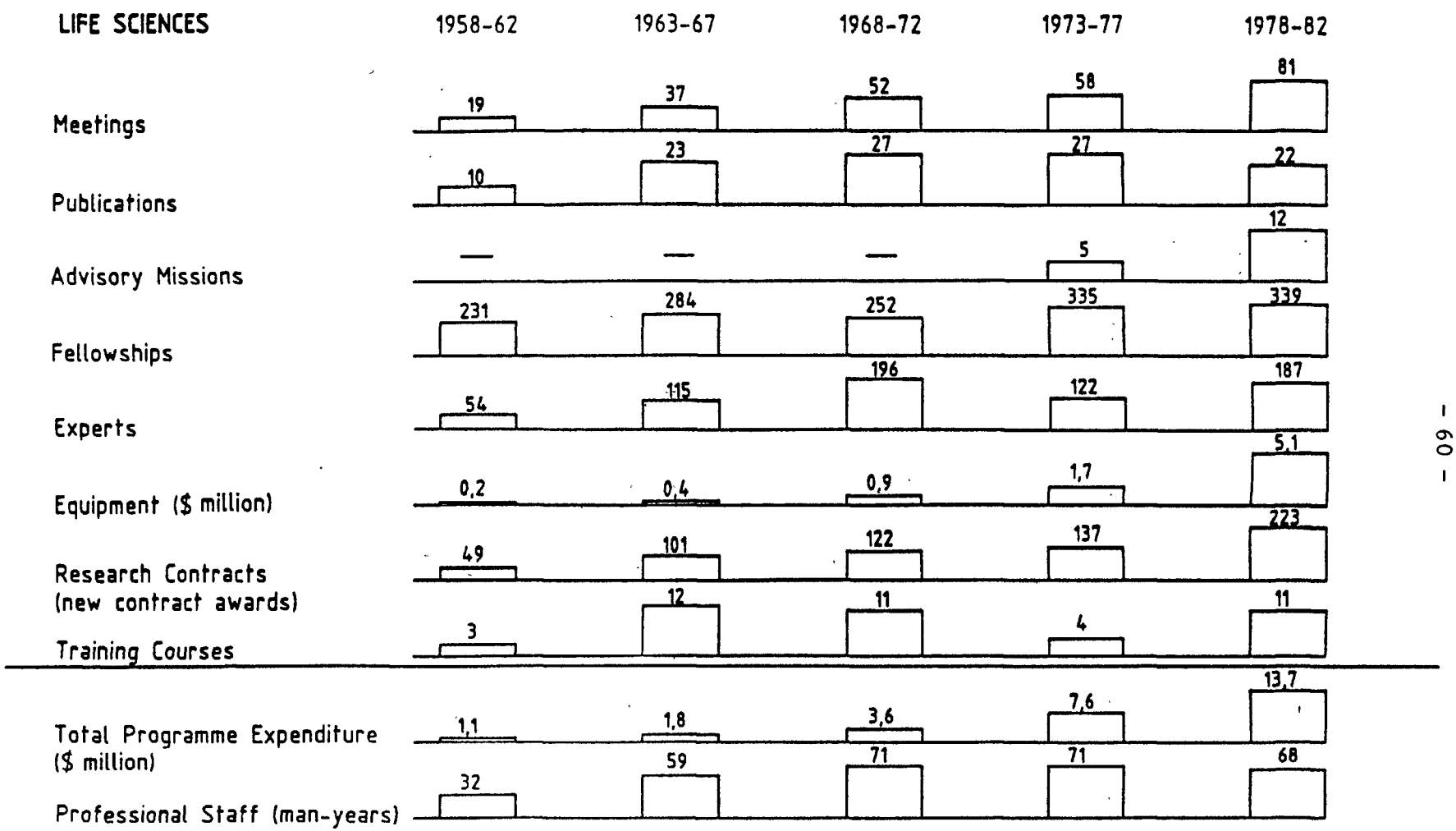

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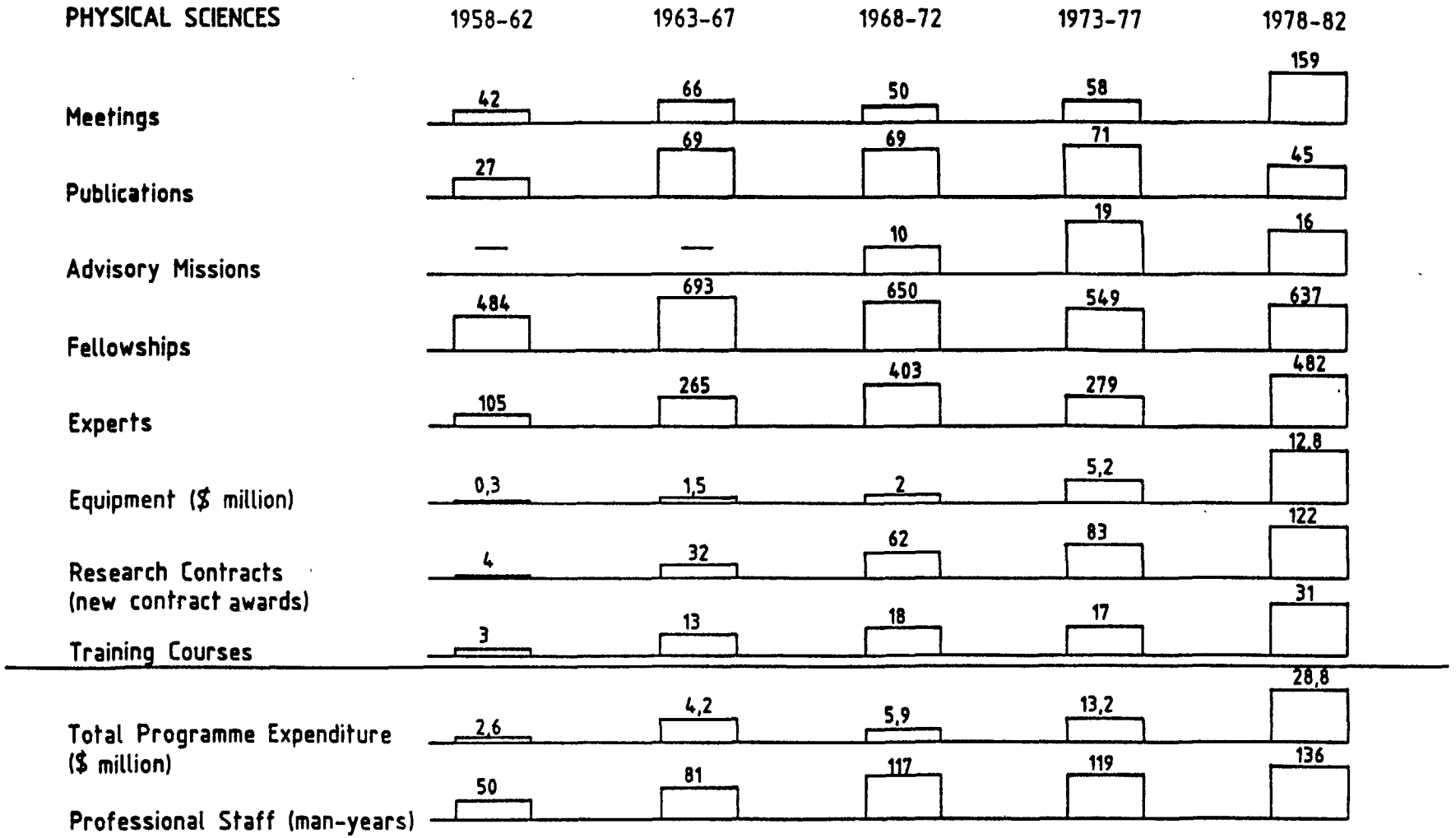


III. THE MAJOR RESULTS AND THE PRESENT SITUATION

1) The Programmes

A) Nuclear Power and Fuel Cycle

Meetings	504
Publications	215
Advisory Missions	79
Fellowships	1731
Experts (total assignments)	1274
Equipment ($ million)	15
Research Contracts (number of new contracts)	127
Training Courses (courses/participants)	53/1153
Total programme expenditure ($ million)	37.5
Total Professional man-years	565

a) Nuclear Power

180. By the end of 1982 only six developing Member States (not including those in Eastern Europe) had installed and were operating a total of nine nuclear power plants with a total capacity of 3100 MW(e) [average plant capacity about 350 MW(e)], and 22 plants with a total capacity of about 14 000 MW(e) were under construction in nine developing Member States. The Agency's programme is directed towards solving the problems which continue to limit the growth of nuclear power in developing countries. The experience gained by the Agency during the past 25 years has led to a comprehensive programme which responds to the growing needs of developing Member States with regard to nuclear power implementation within the framework of an optimized electricity supply system.

181. This programme reflects the fact that the future need for and role of nuclear power can be analysed realistically only within the framework of the total future energy demand and supply situation of an individual country.

182. Thus, the Agency does extensive work on nuclear power planning and implementation, including economic assessments of the role of nuclear power within national energy plans. This work involves three interdependent activities: the development of methodologies specifically adapted to developing countries; the conduct of training courses on energy and nuclear power planning techniques; and the carrying out of nuclear power planning studies in close co-operation with requesting Member States.

183. The Agency has developed nuclear power planning methodologies (WASP and MAED) which are made available for use in developing Member States and have increased the ability of such countries to carry out nuclear power planning studies. By the end of 1982, the WASP methodology had been transferred to 45 Member States and used by them in about 60 planning studies. More than 30 additional studies have been planned.

184. The methodologies used by the Agency are not limited to those developed internally; they include methodologies developed by Member States and made available to the Agency. A basic tool for use with these methodologies and for helping Member States to plan for nuclear power is the computerized Energy and Economic Data Bank (EEDB), which contains basic energy and economic data for all Agency Member States. These data are updated regularly and used in estimating future energy demand and electricity and nuclear power requirements; they are published annually.

185. Assistance to Member States in nuclear power planning is likely to involve closer co-operation with other international organizations, especially the World Bank, in order to ensure that the planning is done in the context of an overall energy programme. Comprehensive case studies of energy demand and supply in developing

countries are a logical extension of this. It is important that such studies include assessments of relevant economic, financial, technical and policy factors, of infrastructure availability and the requirements for developing additional necessary infrastructures, and of the schedule for introducing nuclear power.

186. A series of guidebooks covering all activities involved in planning the introduction of nuclear power and in executing projects is being completed; in fact, some of them are already being updated. The guidebooks still being prepared include ones on electric system expansion planning, project management and bid specifications. The guidebook on economic bid evaluation is being revised to reflect recent experience.

187. The guidebooks have found broad acceptance, as shown by higher-than-average sales figures and their extensive use in Member States. The guidebook "Manpower Development for Nuclear Power" has been translated into a number of languages. The quality assurance code and guides have also found broad acceptance, at least 10 countries - both industrialized and developing - having adopted the code as a national regulation.

188. The emphasis on manpower development is continuing in view of its importance for safety as well as reliability and economics. The Agency's training course programme will thus continue, but more stress will be placed on specialized courses in project and operations management and on safety-related subjects in response to demonstrated needs. The trend towards establishing and strengthening education and training at the national level, while somewhat detracting from the international courses made available through the Agency, is likely to continue; manpower development missions requested by Member States tend to focus on more specific aspects of national requirements and national manpower development programmes.

189. While it is difficult to assess the impact of training programmes in quantitative terms, it is obvious from the extensive use made in Member States of information provided by the Agency that the

1200 trainees who have participated in the nuclear power training course programme have had a considerable influence in their home countries. The benefit of the training courses is apparent also from the improved performance of the national teams participating in nuclear power planning studies undertaken together with the Agency.

190. An industrial support infrastructure is another important pre-requisite for the construction and operation of nuclear power plants. The Agency has, through the organization of expert missions and similar activities, helped in assessing available industrial infrastructures and defining what is needed in addition. A more detailed programme, including a guidebook, is being developed.

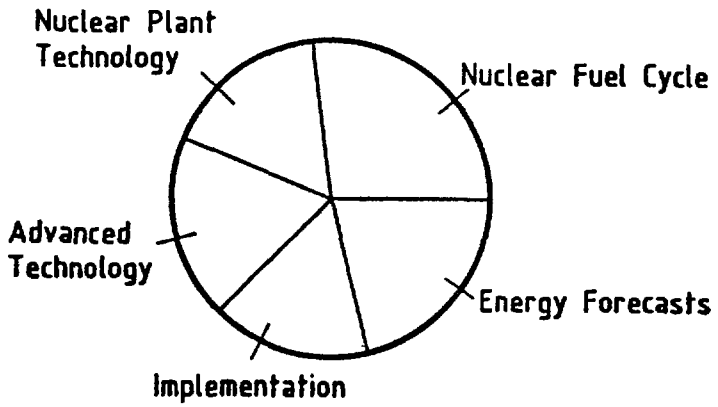
191. For developing countries with nuclear power plants in operation or under construction the Agency co-ordinates a broad exchange of information and experience on the technical and economic aspects of nuclear power in order to provide a better understanding of the technical complexities and unique safety requirements of nuclear power plants and of the economic importance of power plant operating reliability. The computerized Power Reactor Information System (PRIS) contains information on the current status of nuclear power plants in operation, under construction or planned, including basic design data, information on electricity production and data on the reliability of plants and major systems. The data are used for statistical analyses of nuclear power plant operations, the main results being published annually.

192. PRIS is now being used by other international organizations, notably the World Energy Conference, as an authoritative source for power reactor performance data. The number of requests from Member States for specific data sets and analyses are increasing as PRIS becomes more widely known.

193. With regard to small and medium power reactors (SMPRs) the Agency's activities have undoubtedly helped to make manufacturers aware that a significant potential market exists. The present existence of more mature designs is probably a result of this awareness, coupled

with the knowledge that domestic markets for large plants are shrinking. No SMPR projects have yet been launched, but an SMPR project initiation study for which an initiative has been taken may help to change this situation.[25/]

194. The diagram below indicates the relative programme emphasis, in financial terms, being given to the various programme components.



b) Nuclear Fuel Cycle

i) Nuclear Materials

195. The scope of the nuclear raw materials programme has been expanding since the inception of the Agency. The activities in uranium exploration, development and production have closely followed the trend in nuclear power development, the aim being to respond to the needs of Member States.

25/ A technical committee meeting held in 1983 reviewed a proposal for the study and recommended a step-wise approach. Accordingly, a first phase to be carried out in 1984, will assess the general case which can be made for SMPR's on technical and economic grounds based on information from both potential supplier and buyer countries

196. Developing countries in particular have benefited from the information made available through various publications and from the expertise provided by staff members and outside consultants. About 50 developing countries have been visited by technical co-operation missions and have received equipment for their national uranium programmes.

197. Agency technical assistance in the nuclear raw materials field stagnated during the late 1960s, but expansion began in the early 1970s with the worldwide increase in energy exploration activities.

198. Work on uranium geology and extraction is continuing and will result in some major publications in the near future. The data base for ongoing activities such as the computerized information system on uranium geology and the Red Book will be further improved.

ii) Fuel Performance and Technology

199. The proceedings of 18 meetings dealing with materials and their properties, and also many bibliographies and reports on the subject, have been published, and technical assistance has also been provided to several developing countries.

200. At present the activities in this field consist of collecting, evaluating and exchanging information on water reactor fuel element fabrication, quality control and quality assurance and on the behaviour and reliability of fuel under normal and abnormal operating conditions.

iii) Spent Fuel Management

201. The Agency has conducted a world survey of spent fuel storage and is preparing a guidebook which should be of considerable use to Member States.

202. Work on spent fuel transportation and storage is continuing, and a co-ordinated research programme on the behaviour of spent fuel assemblies in extended storage has been initiated.

B) Nuclear Safety and Waste Management

Meetings	664
Publications	228
Advisory Missions	215
Fellowships	680
Experts (total assignments)	787
Equipment ($ million)	4.7
Research Contracts (number of new contracts)	294
Training Courses (courses/participants)	46/966
Total Programme Expenditure ($ million)	52.3
Total Professional man-years	531

a) Nuclear Safety

203. The overall safety record of commercial nuclear power generation has been good, and the Agency has a significant role to play in helping to maintain and improve this record. The focus of the Agency's safety activities is shifting from the in-house preparation of guidelines and reports towards more direct field contacts with Member States and towards implementation of the numerous safety guidelines which have been developed.

204. From its inception, the Agency has provided direct assistance to Member States in the form of advisory missions and technical assistance in health and safety matters. At first the advice dealt mainly with the siting and construction of research reactors. Then, as Member States began to embark on nuclear power programmes, the Agency provided assistance in setting up regulatory bodies and in selecting sites for power plants. More recently, as the number of Member States with operating reactors has increased, advisory missions have dealt mainly with the evaluation of hazards connected with reactor

operations. Plans are being made for the establishment of operational safety review teams which could respond to requests from Member States for help in determining whether an adequate level of safety is being maintained during the operation of power plants. Reviews will be performed for regulatory bodies, and they will deal with such matters as the safety aspects of management and organization, quality assurance, radiation protection and waste management.

205. One of the major radiological safety guidelines is contained in the Basic Safety Standards for Radiation Protection, which were revised and updated in 1982 so that they now incorporate the new ICRP dose limitation system, the key element of which is a requirement that radiation exposure be kept as low as reasonably achievable, social and economic factors being taken into account. The present emphasis is on providing guidance for the practical application of the Basic Safety Standards. These were co-sponsored by the World Health Organization, the International Labor Organization and the Nuclear Energy Agency of the OECD to provide jointly on a world wide basis harmonized and up to date radiation protection standards.

206. The NUSS codes and guides, which are nearing completion, represent an ambitious programme covering all major aspects of nuclear power plant safety, setting internationally agreed standards and providing guidelines for meeting these standards. The five codes of practice and 33 of the safety guides have been published in English and most of them have also already been translated into French, Russian and Spanish; and the remaining guides are well under way. Efforts to encourage and assist Member States in the use of these documents are being reinforced through seminars, training courses and special advisory missions.

207. The Agency's Regulations for the Safe Transport of Radioactive Materials, first issued in 1960, are undergoing a comprehensive review. The Agency provides assistance to Member States in implementing them. Other guidelines nearing completion are a revised code of practice for research reactors and a new version of the Standards for Radiation Protection in the Mining and Milling of Uranium.

208. The Agency promotes information exchange among Member States in a variety of forms. An exchange of computer programs frequently used in safety evaluations has been started and experts from Member States have access to the Agency's computer for aid in solving safety-related problems.

209. Assistance in emergency planning is receiving increased attention. The recognition has grown that the effort involved in handling a nuclear power plant accident with potentially serious radiological consequences might well be beyond national capabilities and that there might well be transboundary consequences - particularly in the case of plants in border areas. The need for a comprehensive approach is apparent, and the Agency recently convened a group of experts to study the constraints to co-operative efforts - financial considerations, legal liability, customs and immigration problems, etc. - and to determine the most appropriate means of overcoming them. In addition, special assistance missions have been offered to Member States to review and evaluate the emergency plans for their power plants.

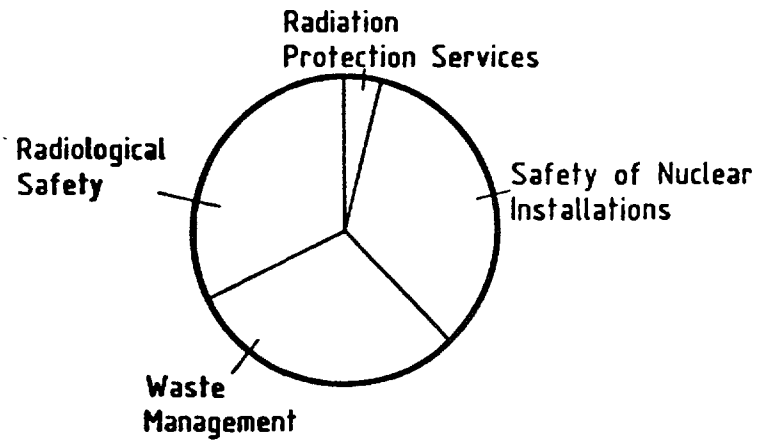
210. Another recent initiative is the establishment of a comprehensive Incident Reporting System, the purpose being to collect the wealth of data in many countries concerning events which have occurred. Such data could help in recognizing the causes of accidents and methods for avoiding and dealing with them. As a step toward making the data compatible, guidelines for national incident reporting systems have been prepared and meetings involving the participation of NEA and CMEA members and of developing countries have been held.

211. The Agency is also encouraging international co-operation in nuclear safety research through shared technical and budgetary resources. This would open the door for small countries to participate in research which they could not normally undertake. A number of meetings have been held to identify subjects of interest and discuss possible exchanges of scientists from different Member States.

212. These newer initiatives complement the Agency's ongoing work, which covers the broad spectrum of nuclear safety. A total of 38 symposia and 21 seminars were held in the 25-year period, and the proceedings of most of these have been published for permanent reference. Training courses and regional study group meetings are another important means of disseminating information, and these activities are still increasing.

213. Thus, the Agency has been working in many areas to develop mutually agreed standards, to determine what are acceptable levels for safety and to help Member States achieve these levels. In a period when the development of nuclear power in some countries is limited more by lack of public acceptance than by technological constraints, this work can provide an important stepping-stone towards both technological improvements and public acceptance.

214. The relative emphasis, in financial terms, given to radiological safety, the safety of nuclear installations and radiation protection service is shown in the following diagram.



b) Waste Management

215. Information on waste management has been collected and revised through the holding of symposia, seminars and technical committee meetings and through co-ordinated research programmes, special questionnaire actions and the operation of INIS. It has been disseminated in symposium and seminar proceedings (26 volumes), in the Technical Reports Series (40 reports), in the Safety Series (20 documents), as unpriced IAEA-TECDOCs (22 reports) and as Waste Management Research Abstracts (14 issues).

216. The Agency has supported scientific research in selected fields of waste management by organizing co-ordinated research programmes and awarding contracts to laboratories in industrialized and developing countries. Also, the Agency has organized training courses, study tours and scientific visits, awarded fellowships, arranged expert missions, provided field experts and assisted in the implementation of projects in Member States.

217. The current waste management programme falls under the headings "handling and treatment of radioactive wastes at nuclear facilities", "underground disposal of radioactive wastes" and "environmental aspects of nuclear energy". The main activities are: collecting, reviewing and updating technical information on the management of all types of waste; developing guidelines for waste disposal; preparing recommendations in connection with conventions on protection of the environment; and providing methodologies for assessing the environmental impacts of nuclear facilities.

C) Safeguards

States with safeguards agreements	90
Research reactors and critical assemblies under safeguards or containing safeguarded nuclear material	177
Nuclear power reactors under safeguards or containing safeguarded nuclear material	143
Conversion, fabrication and reprocessing plants under safeguards	49
Source material under safeguards (000 tonnes)	25
Number of inspections 1968-82	9600
Total programme expenditure ($ million)	147.4
Professional staff (at end of period)	228

218. Safeguards are essentially a technical means of verifying the fulfilment of political obligations undertaken by States in concluding international agreements relating to the peaceful uses of nuclear energy. Today most of these obligations flow from NPT and similar legal instruments.

219. The main objectives of safeguards are:

to assure the international community that States are complying with their non-proliferation and other "peaceful use" undertakings; and

to deter (a) the diversion of safeguarded nuclear material to the production of nuclear explosives or for other military purposes and (b) the misuse of safeguarded facilities with the aim of producing unsafeguarded nuclear material.

220. The main results of the application of Agency safeguards over some 20 years are:

(a) no diversion of any safeguarded item has been identified
(b) safeguards have been accepted by almost all non-nuclear-weapon States having significant nuclear activities.

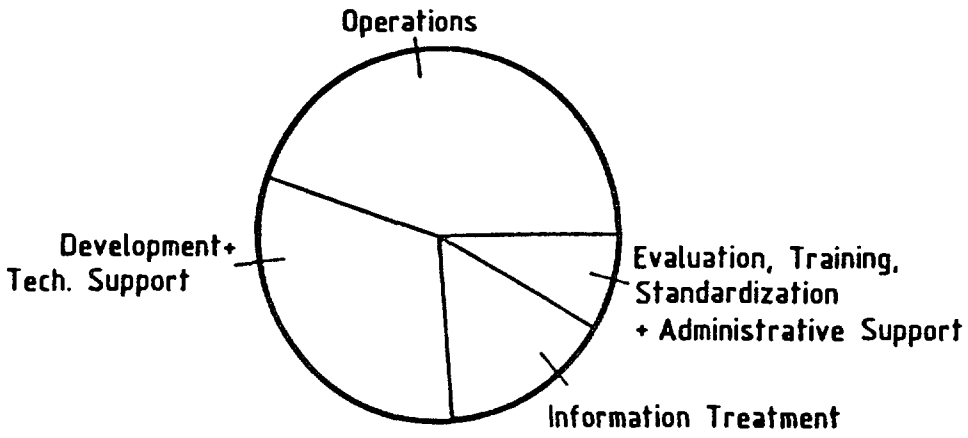
221. The first result provides confidence that material or installations subject to safeguards are not being used for the development of nuclear weapons programmes. This confidence contributes to mutual trust among nations and consequently to the preservation of peace.

222. The second result implies that safeguards are playing a significant role in contemporary political developments. The general acceptance of safeguards has required that the concept of national sovereignty be seen in a new light. Nations accepting safeguards have shown their readiness to accept the limitations on national sovereignty which safeguards involve in furtherance of the common interests of the international community. The Agency was the first international organization to conduct inspections of any kind in the territory of sovereign States, and has thus been involved in the development of modern political concepts.

223. World peace and political evolution are the concern of all States, but there is also little doubt that international stability is essential in order for developing countries to realize their potential. In this sense the Agency's safeguards may claim to have made a modest contribution to the welfare of all States, including the developing countries.

224. Also, the widespread acceptance of Agency safeguards has contributed to a freer flow of nuclear material, equipment and information, with corresponding benefits for both suppliers and recipients.

225. The relative emphasis, in financial terms, given to the major safeguards activities, is shown below.



D) Radioisotope and Radiation Applications

a) Food and Agriculture

Meetings	337
Publications	138
Advisory Missions	9
Fellowships	1264
Experts (total assignments)	1280
Equipment ($ million)	15.2
Research Contracts (number of new contracts)	631
Training Courses (courses/participants)	93/1568
Total Programme Expenditure ($ million)	39.7
Total Professional man-years	259

226. The applications of isotopes and radiation in relation to food and agriculture have proven to be both varied and effective. The use of radiation to improve crops has resulted in the development of about 200 varieties over the past 25 years, and a number of these have been bred by holders of Agency research contracts and agreements or by scientists participating in technical co-operation projects. Methods developed by the Agency in connection with the sterile-insect technique have been employed in eradicating the Mediterranean fruit fly (medfly) from a developing Member State over a three-year period, reducing agricultural losses by tens of millions of dollars each year.

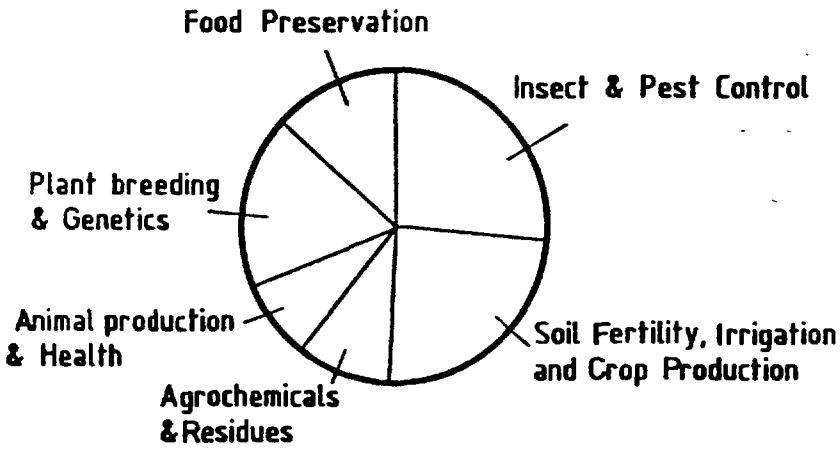
227. Work on the wholesomeness aspects of food irradiation has helped clear the way towards the acceptance of irradiation as a food preservation method rather than a food additive. This in turn has led to the widespread issuing of clearances for food irradiation as a commercial method of preserving a variety of foodstuffs.

228. Isotope-aided techniques have been used extensively to improve the fertility of soils, to increase the efficiency with which crops take up nutrients and applied fertilizer from the soil, and to find the optimum means of improving the water status of soil and of enhancing water uptake by crops. In one case, annual savings estimated at more than $ 30 million were achieved after farmers had adopted the findings of an isotope-aided programme on the efficient placement of fertilizer in maize.

229. The use of radioimmunoassay techniques for measuring reproductive hormones in milk and blood has contributed significantly to increasing the reproductive efficiency of dairy cattle and buffalo in many Member States, and ionizing radiation has been used successfully to produce an attenuated vaccine against lungworm in cattle and sheep; this technology has been transferred to areas of the world where control of this parasitic disease is of economic importance. Isotopic labelling, which is a unique tool in studies of agro-chemical residues and pollution, is now being used extensively in developing Member States.

230. The main factors influencing these programme activities will continue to be the increasing world population, the need to reduce the energy inputs into agricultural and animal production, the continuing degradation of arable land, the continuing loss of arable land to other uses, and the need to protect the environment. Given the importance of increasing yields and ensuring greater food supply, isotope and radiation techniques will continue to be major tools.

231. The relative emphasis, in financial terms, given to the 6 principal programme activities is shown in the diagram below. As will be noted, expenditure is heaviest for soil studies and plant breeding and pest control work as these are essential for improving the yield and ensuring the marketability of a number of crops of critical importance to the developing countries.



232. Nearly the entire programme has been oriented towards the problems of developing countries. The programme mechanisms employed are likely to remain the same. Research is a major component, and over 300 research institutes and experimental stations in Member States are now co-operating under research contracts or agreements in nearly 30 co-ordinated programmes.

b) Life Sciences

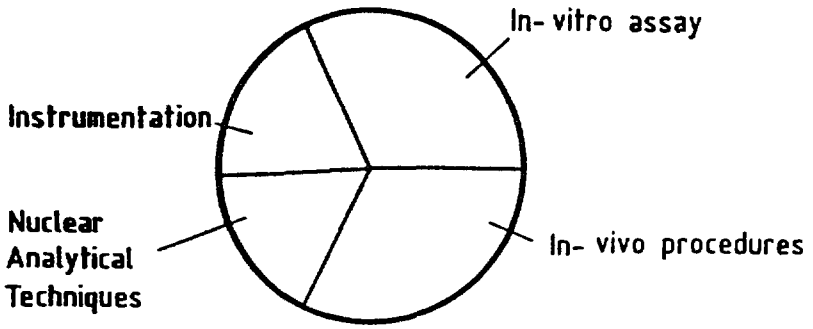
Meetings	247
Publications	109
Advisory Missions	17
Fellowships	1441
Experts (total assignments)	674
Equipment ($ million)	8.3
Research Contracts (number of new contracts)	632
Training Courses (courses/participants)	41/701
Total Programme Expenditure ($ million)	27.8
Total Professional man-years	301

i) Medicine

233. During the past 25 years, the use of radionuclides and radiation in clinical medicine and the medical sciences has expanded dramatically. In developing countries, part of the expansion can be attributed to the training, equipment and experts provided by the Agency.

234. In instrumentation, awareness has spread of the need for care in the selection of equipment, power conditioning, preventive maintenance and local training initiatives. It is now widely recognized that errors are common in clinical applications of radionuclides, both in vitro and in vivo, but that they can be identified and eliminated. Analytical quality control reference preparations distributed by the Laboratory have successfully focussed attention on the pitfalls of trace element measurements in biomedicine using activation analysis, and have led to a higher quality of work at research reactors in many developing countries.

235. Radionuclide and radiation applications in medicine are now well established in many developing countries. However, with the continuing developments in this area as a result of the availability of more suitable radionuclides and advances in electronics, the retraining and new infrastructure requirements are very substantial. Strong emphasis is therefore now being placed on up-grading the quality of medical work in developing countries through the improved maintenance of instruments and the quality control of in vitro assay procedures, in vivo investigations and nuclear techniques for the analysis of elements of biomedical significance. The relative emphasis, in financial terms, being given to the various programme components is shown below.



236. As to the techniques themselves, it is evident that radioimmunoassay and related procedures will grow in reliability and applicability, and it is probable that the use of non-radioactive tracers will grow in relative importance. Breakthroughs in the use of these techniques are likely to increase their relevance to developing countries. There are many ways of increasing the efficiency with which they are used in developing countries - especially improvements in local organization and regional co-operation.

237. Neutron activation will undoubtedy continue to be the method of preference for analysing many trace elements of importance in public health, though this is likely to be of less direct application in developing countries as a whole. The electronic revolution will

continue to bring rapid changes in the technology of nuclear medicine instrumentation, as a result of which sustained efforts will continue to be required in order to ensure that greater attention is given to the special needs of the developing countries and that these are enabled to make proper use of the more advanced techniques.

238. In the medical field, the traditional technical assistance mechanisms will continue to be of importance, as will research activities. The latter will be directed in part towards activities designed directly to benefit developing countries and in part towards the further development of new or improved techniques of general usefulness.

ii) Radiation Biology and Dosimetry

239. The microbicidal effects of exposure to penetrating ionizing radiation form the basis for the radiation sterilization of medical supplies. Regionally co-ordinated research programmes have helped to standardize radiation sterilization practices and contributed to the formulation of an international code of practice. Recent radiobiological research has improved the quality of the practices employed in cancer radiotherapy. The radiation attenuation of parasitic organisms (with their concomitant retention of immunogenic properties) has helped in the development of potent vaccines for the control of parasitic diseases prevalent in developing countries.

240. Activities relating to the manipulation of radiosensitivity effects will continue to be required, and they will be carried out in close co-operation with WHO. A programme for the evaluation of different environmental protection policies will be carried out in co-operation with FAO, UNEP and WHO.

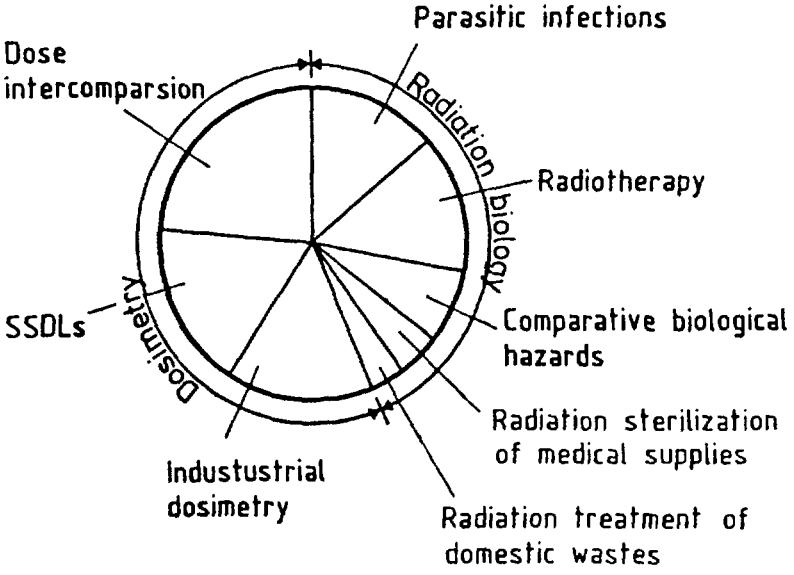
241. Despite the fundamental nature of the studies supported in radiation biology, nearly 70% of all research contracts or agreements in this field over the past decade have been awarded to or concluded with institutes located in developing countries. This is due partly to the increasing competence in this field now demonstrated by a number of

developing countries and partly to efforts that have been made to identify areas in which the developing countries could make a contribution with regard to topics of direct interest to themselves. At the same time, the number of developing countries participating in such work is still small in relation to the total number of developing countries.

242. In the Agency's early days there were no international dose standards; accordingly, the Dosimetry Laboratory designed and built an absorbed dose calorimeter which has often been used for absolute dose determinations and for intercomparisons with reference instruments at national primary standard laboratories. On the basis of this work, a postal dose intercomparison service for cobalt-60 dosimetry was established for radiotherapy institutes in developing countries. This service - for which no charge is made - has led to improvements in dosimetry at some 200 institutes.

243. Before 1970, no standards laboratories existed in any developing country. The Agency therefore established, in 1976, jointly with WHO, the IAEA/WHO Network of Secondary Standard Dosimetry Laboratories (SSDLs). Today there are 45 SSDLs in the Network, 30 of them in developing countries. They fulfil a vital function as national metrology organs, and their work is guided and harmonized by the Agency's Dosimetry Laboratory, which serves as a central laboratory for the Network.

244. Activities in the field of dosimetry will continue to be systematically extended as required, primarily through assistance in the establishment of SSDLs and through the postal dose intercomparison service. In future, greater attention will be given to high-dose intercomparisons as a basis for the development of international recommendations and of an international high-dose quality assurance service, which may well encompass commercial irradiators. The relative emphasis, in financial terms, given to the various programme components is shown in the following diagram.



c) Physical Sciences

Meetings	375
Publications	281
Advisory Missions	45
Fellowships	3013
Experts (total assignments)	1534
Equipment ($ million)	21.8
Research Contracts (number of new contracts)	303
Training Courses (courses/participants)	82/1430
Total Programme Expenditure ($ million)	54.7
Total Professional man-years	503

i) Hydrology

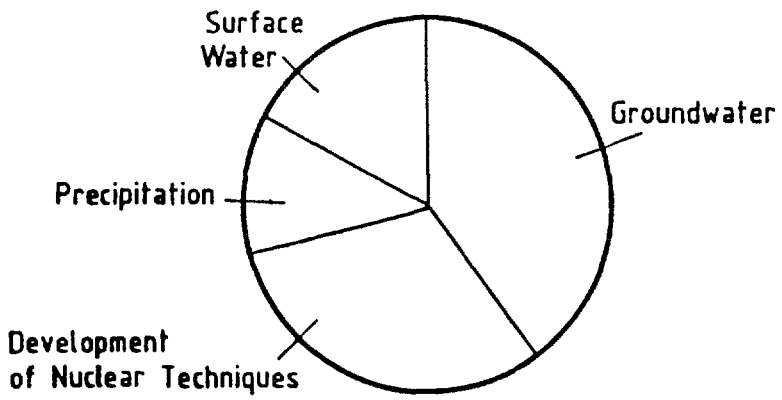
245. Twenty-five years ago isotope hydrology was very much in its infancy, and the Agency played a major part in the development and introduction of isotope hydrology techniques. Advisory groups helped to identify promising applications, which were supported by research contracts. The first comprehensive publication on this subject, the Guidebook on Nuclear Techniques in Hydrology, appeared in the late 1960s and informed hydrologists of a broad range of applications.

The fact that this guidebook was prepared during the International Hydrological Decade led to a rapid introduction of isotope hydrology in developing countries.

246. In many developing countries, isotope hydrology techniques were introduced by the Agency through large-scale UNDP-supported groundwater projects.

247. An Agency/WMO survey of isotopes in precipitation provided the basic data necessary for using environmental isotope techniques in countries all over the world, regardless of their degree of development. Countries not having the necessary analytical capability were not prevented from introducing these techniques, as the Agency's Isotope Hydrology Laboratory provided the analytical support. The Laboratory continues to play an important training and analytical quality control role for newly established laboratories.

248. Hydrological techniques involving the use of radioactive isotopes either intentionally injected into or already present in the environment are today employed for a variety of water movement studies of particular importance to countries in the arid zones and also for relatively new studies relating to waste disposal and geothermal energy. Much of the Agency's effort in this field is directed towards the development of techniques and the provision of laboratory services, and the conduct of studies of direct interest to a number of developing countries requiring more adequate information about their water resources. The relative emphasis, in financial terms, given to these various aspects is shown below.



249. The Agency will continue to co-operate closely with WMO, FAO, UNESCO, UNEP and other organizations of the United Nations family.

250. Although a number of pioneering studies in isotope hydrology have been carried out by the Agency in developing Member States, often under contract to other United Nations organizations, only a few of these countries are at present in a position to apply isotope hydrology techniques directly themselves; for this reason, even greater attention will be paid to the transfer of such techniques. In addition to the programme that has been in progress for several years under the RCA, the Agency is now initiating a similar major co-ordinated programme in another region.

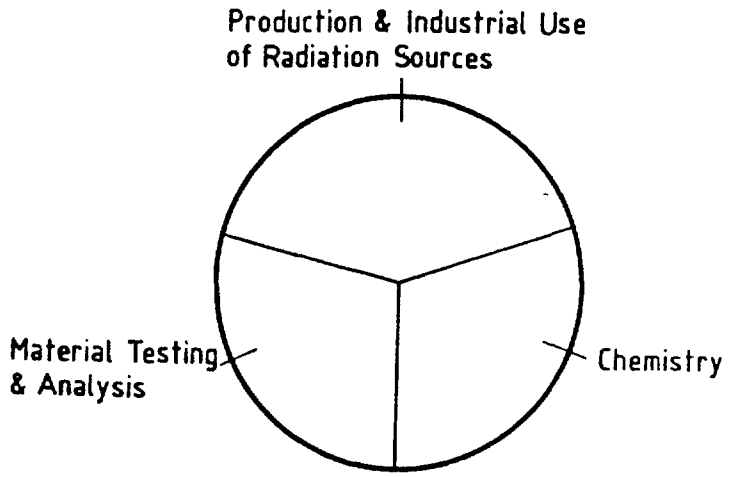
251. The Agency has assisted in the establishment of more than 20 environmental isotope laboratories. Because of the sophisticated nature of the analytical techniques required, considerable effort will continue to be necessary in helping Member States to develop an isotope hydrology capacity. Although the techniques can be acquired more or less independently of other nuclear activities, the infrastructure requirements are not insignificant and countries need both a relatively high level of ability in chemical analysis and specialists in geology and hydrology; however, these prerequisites are becoming more widespread.

ii) Industry

252. Systematic efforts directed towards the promotion of industrial applications of radioisotopes and radiation technology in both industrialized and developing Member States have helped to establish the industrial use of nucleonic control systems, the use of nuclear analytical methods in mineral exploration and the industrial use of large radiation sources. Tracer technology has become generally adopted and radioisotopes are produced in large amounts.

253. Isotope and radiation applications have become commonplace in a number of industries, being involved in such diverse activities as wear and corrosion studies, non-destructive testing, sterilization, on-line control, and the exploration and recovery of minerals. Several developing countries are employing isotope and radiation techniques, and it is anticipated that their use in other developing countries will increase rapidly, for in many cases the cost-benefit ratio is high and the technology has been proven.

254. The Agency serves as a channel for information on those industrial applications of radioisotopes and radiation technology which are considered to be of highest potential benefit to its developing Member States. These relate primarily to the production of isotopes, labelled compounds and radiopharmaceuticals and to the use of nuclear techniques in the exploration and processing of natural resources. The relative emphasis, in financial terms, given to the various programme components is shown below.



255. Though the scale of activity is not large, substantial advice is being provided to Member States and research is being supported in several areas; also, a large-scale UNDP programme has been implemented within the framework of RCA.

256. Impetus has been given to this subject area recently through a UNDP project which is being carried out within the framework of RCA and in which 11 industrial installations are planned for practical demonstration and gaining experience.

iii) Physics and Chemistry

257. During the period under review applied nuclear physics laboratories have been established in more than thirty Member States. With technical guidance from the Agency, some of these laboratories, which were established mainly at universities, have become national laboratories. Their programmes are oriented towards analytical nuclear techniques such as X-ray fluorescence, Moessbauer spectroscopy, low-level counting and gamma spectroscopy; frequently the teaching component is emphasized, providing the basis for the development of technical and scientific manpower. In support of this, the Agency's activities include the exchange of information on nuclear techniques suitable for developing laboratories and on nuclear instrumentation (including electronics). A number of Agency publications have resulted from this work.

258. The Agency has given considerable attention to the development of programmes for the utilization of research reactors and to reducing the enrichment of research reactor fuels.

259. Agency meetings on fusion, especially the regular large Agency conferences and the meetings of the International Fusion Research Council (IFRC), have become important mechanisms for information exchange and for the co-ordination of research effort.

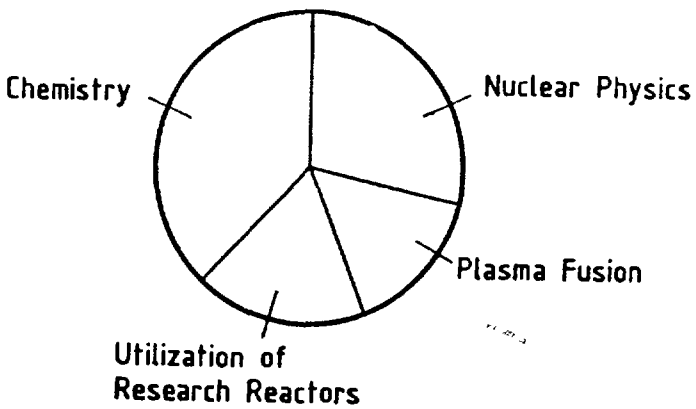
260. Activities continue to be supported in selected fields of nuclear physics and solid state physics and in nuclear instrumentation. Substantial efforts are being made to assist Member States in making better use of low-energy accelerators as well as of research reactors.

261. The Agency will continue to support INTOR as required and to seek fusion topics for research at smaller laboratories in Member States. In addition to physics-related studies of thermonuclear reactions and facilities, increased attention is being given to the chemical aspects of fusion reactor technology.

262. Publication by the Agency of a compilation of thermodynamic data and the preparation of chemical standards for nuclear fuel analysis and safeguards purposes have represented substantial contributions in the field of nuclear materials chemistry.

263. Support will continue to be required for basic chemical analysis technologies, and emphasis will continue to be given to the preparation and use of radiopharmaceuticals and other labelled compounds. When requested, the Agency will continue to assist Member States in developing their ability to use nuclear analysis methods. Also, it will continue to ensure the availability of certain chemical standards.

264. Areas of major emphasis are shown in the following diagram.



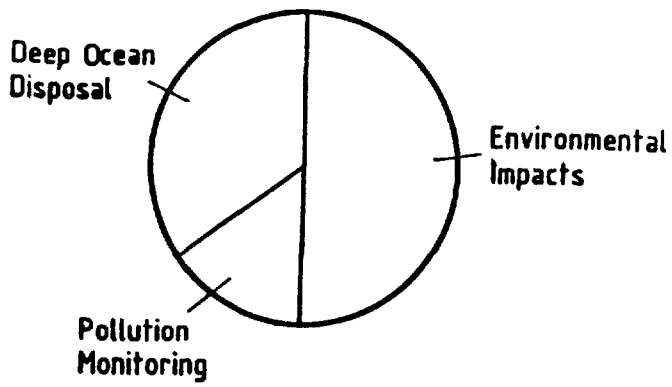
265. The development and implementation of training methods for education in the physical sciences represent a substantial part of the programme relating to applications of radioisotopes, nuclear and atomic analytical techniques, radiochemistry and nuclear instrumentation. The use of microcomputers in various areas of nuclear technology is being given increasing attention.

iv) Monaco

266. The Laboratory has become increasingly active in the UNEP action plans relating to the Mediterranean, the Gulf and the West and Central African region, which involve the identification and measurement of radioactive and non-radioactive pollutants in the sea.

267. Because of limited space it has been difficult to accept many individuals for training. Nevertheless, over the past decade some 25 scientists and technicians from developing Member States have received training in radiochemical and radiobiological methodologies. The trainees were from countries which have a substantial interest in oceanography and have already developed considerable competence in various analytical techniques. As a result of the recent move of some of the Laboratory's facilities to a new building, it will be possible to accept a larger number of trainees in future; it is expected that training will now be provided for up to ten individuals a year for periods ranging from a few weeks to several months.

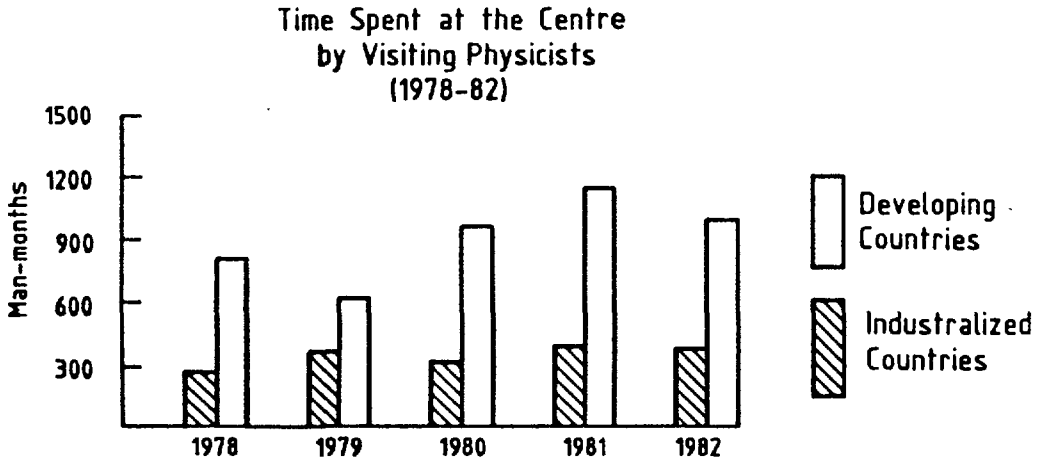
268. The technical objectives of the Laboratory's programme are directly related to activities in both the Department of Nuclear Energy and Safety and the Department of Research and Isotopes. The programme focuses on problems connected with the ocean dumping of radioactive wastes, while making provision for the quality control of radiochemical analyses of samples from the marine environment, training in radioecological subjects and support of work done by other international organizations. The relative emphasis given to the programme segments is shown below.



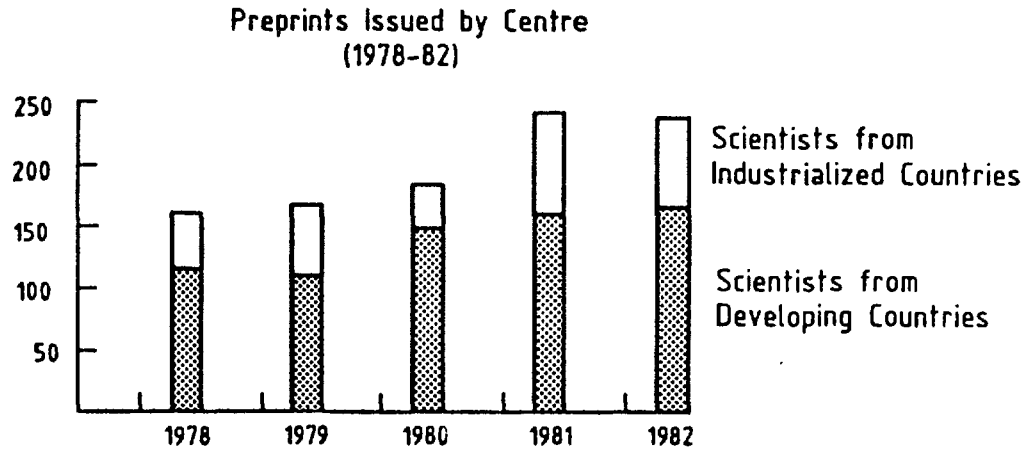
269. Broadly speaking, the Laboratory's programme is similar to technical programmes carried out within the Agency, but with research and the provision of analytical services and training in addition. Its value to the developing countries around the Mediterranean basin has been demonstrated, and further direct contacts with developing countries will doubtless result from the Laboratory's efforts to increase the available data on the distribution and fate of radionuclides in the southern hemisphere and from its growing ability to accept trainees. Since the techniques involved in the analysis of radioactive and non-radioactive contaminants are essentially the same, the Laboratory can assist developing countries in programmes related to both radioactive and non-radioactive contamination of the marine environment.

E) International Centre for Theoretical Physics

270. The amount of time spent at the Centre by visiting physicists during the past five years is shown in the following diagram.



271. The diagram below indicates the total number of preprints issued by the Centre over the past five years as well as the relative share produced by scientists from the developing countries and the industrialized countries.



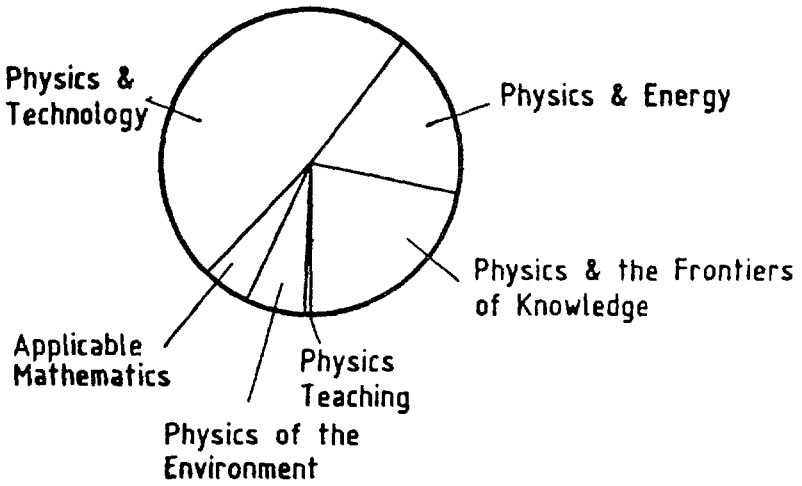
272. Since the Centre's inception nearly two decades ago, the major thrust of its activities has been to provide a meeting place where scientists from the Third World can do research and participate in courses or seminars in their particular field. About 1000 scientists from developing countries now visit the Centre annually, spending on average somewhat more than one month; some 200 scientists are currently "Associates" of the Centre, and about 60 "Federation Agreements" have been concluded with physics institutes in developing countries. More than 150 preprints prepared by authors from developing countries are produced annually.

273. Because of the Centre's high reputation, the wide range of activities carried out in a number of fields, and the emphasis over the past decade on solid-state physics and more recently on subjects such as monsoon dynamics and the physics of deserts, there is a very strong interest among physicists in developing countries in participating in the Centre's activities.

274. Until last year, the Centre did not have links with experimental facilities. As a result of arrangements made with the Italian Government, however, it is now possible for scientists working at the Centre to make extended visits to Italian laboratories.

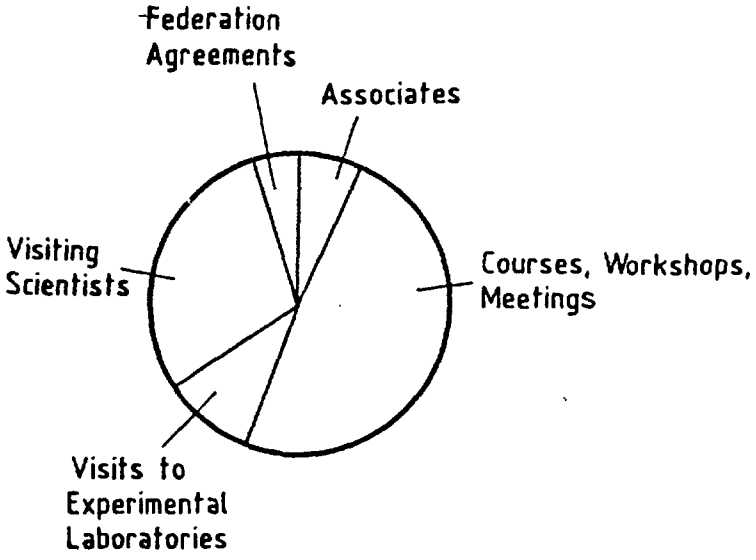
275. As the role of basic science in the development and sustainment of modern industrial societies becomes more widely understood, greater emphasis will be placed on the development of centres of scientific excellence in developing countries. It is therefore likely that the Centre will become even more important as a factor in the process of scientific development.

276. Because of the nature of the Centre as a research and training institution operated jointly by UNESCO and the Agency, its programme is different from those carried out at Headquarters. The emphasis, in financial terms, given to various areas of physics shown below.



277. The activities in these areas are supported in a number of ways: the appointment of Associates, the conclusion of Federation Agreements, the appointment of visiting scientists, the holding of courses and seminars, and the participation of scientists from developing countries in research at Italian experimental institutes. So far, nearly all courses have been held at the Centre; however, in an effort to encourage work in developing countries the Centre is now providing limited financial support for selected locally organized activities and planning for a small number of courses to be held away from the Centre.

Mechanisms Employed



2) The Mechanisms

A) Technical Co-operation Activities

278. The mechanisms employed by the Agency so far - experts, fellowships, equipment, training courses, scientific visits and technical missions - are employed throughout the United Nations system, and the activities of the Department of Technical Co-operation are well integrated into the pattern of such activities conducted throughout that system. These mechanisms are applicable in varying degree to all developing countries, and the Agency's procedures are flexible enough to permit the use of any combination of mechanisms. Also, the procedures provide for monitoring and review and for the introduction of any changes which may become necessary or desirable.

279. Because of the need for detailed planning and co-ordination at the national level and within the Agency, the time required from the initial conception of a project or other activity until its implementation is considerable. It is important that this time be kept to a minimum, and substantial efforts have been and will continue to be made to achieve this.

280. There has been no basic change with regard to the framework for technical co-operation activities since their introduction at the Agency. The programme is prepared on an annual basis, although multi-year projects have increased in number during recent years. The multi-year concept has made it possible to plan projects in a comprehensive manner rather than piecemeal and has helped Member States to plan in terms of national priorities, subject to expectations about the Agency's future resources.

281. In the early years, requests normally related to the introduction of nuclear techniques in various fields, now, there is a trend towards more sophisticated requirements in a number of Member States. It is therefore more necessary than ever to take into account the state of the art in and the development objectives of requesting countries, for a given topic may be appropriate in one case and premature in another.

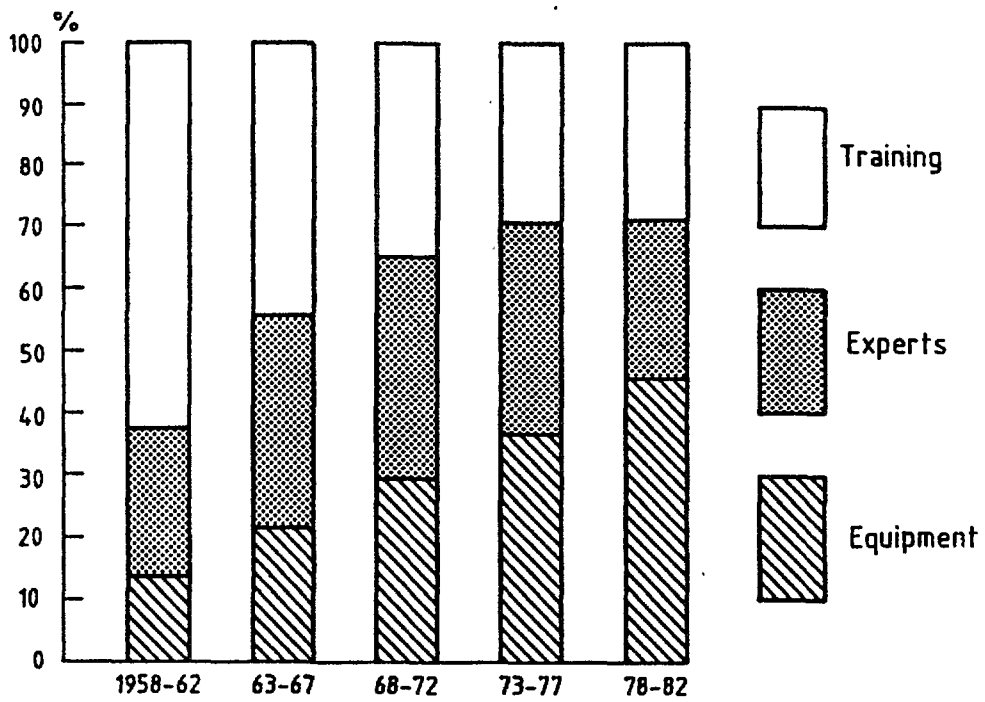
282. In accordance with suggestions from Member States, several regional and inter-regional projects have been developed during recent years. Most of these projects have been designed by the Secretariat and offered to interested Member States. Such projects often combine all technical co-operation mechanisms with research activities funded through contracts. The flexibility in programming thus gained has generally proved to be very useful.

283. The administration of technical co-operation programmes has been constantly improved in order to cope with increasing demands. During recent years, computerization has led to a better monitoring and to a more efficient utilization of programme resources. Reserve Fund facilities and programme modification possibilities are being used to meet the urgent needs of Member States.

284. The important role played by UNDP Field Offices should be noted; they provide the Agency with indispensable facilities, not only in connection with UNDP projects but also for the Agency's own programme.

285. The technical assistance provided over the 25-year period is indicated in the following chart. As can be seen, the training component has declined steadily in relation to the others, while there has been a steady growth of the equipment component; the proportion of experts provided has remained roughly the same. At the beginning of the 1970s each of the three components accounted for about one-third of the total. By 1982, however, the equipment component exceeded one-half of the total, with the other two components accounting for about one-quarter each.

Technical Assistance Provided, by Component



Training

286. The fellowship programme is handled separately from the so-called "projects", which consist of the provision of expert services and equipment. During recent years, however, governments have been

encouraged to submit their project-related training requirements together with their proposals for technical co-operation projects, and the number of fellowships requested has been steadily increasing. More efficient overall planning of projects is achieved through the making of combined submissions.

287. As to the training requirements themselves, there has been a clear change over the years. Initially, the training sought tended to be of an academic nature and the placement of fellows was in general not difficult. Later, the emphasis switched to on-the-job training in areas such as uranium exploration, ore processing, the construction and operation of nuclear power plants, and safety analysis. As a rule, this type of training is best given by commercial enterprises, but the Agency often receives negative answers to its inquiries from such enterprises.

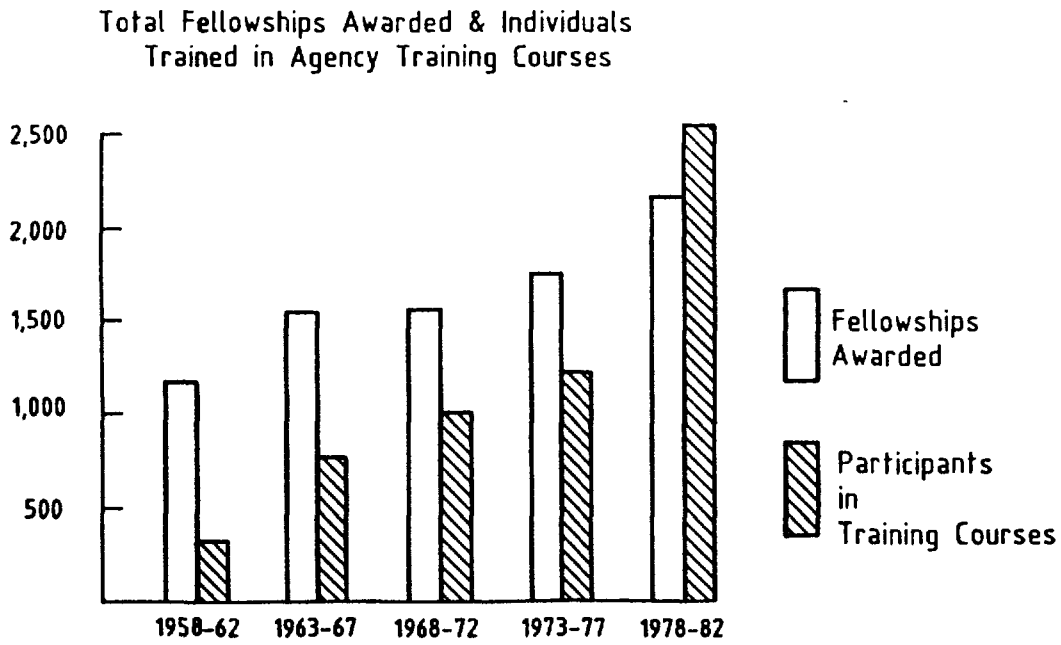
288. In view of this, the Agency developed training courses of its own during the last 5-year period - in uranium prospecting, energy planning, nuclear power, nuclear safety, safeguards, physical protection and emergency planning. To this end, valuable contributions were made by certain industrialized Member States and the Secretariat's resources were strengthened through the establishment of a special section for training courses. The Agency's technical staff has participated strongly in these efforts.

289. The concentration on training as a vehicle for technical co-operation during the early years of the programme has had remarkable results. A very large proportion of former trainees have served as Technical Officers in the Agency, as specialists in governments or as experts in technical co-operation projects. In 1982, more than 50% of the leading counterpart positions in Agency-assisted projects were occupied by former holders of Agency fellowships.

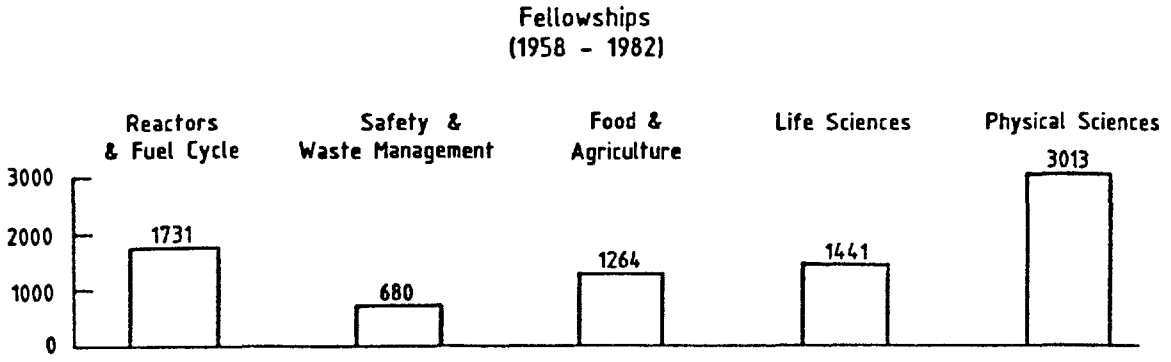
290. The following chart shows a continuing increase in the number of fellowships awarded and of participants in Agency training courses over the 25-year period, with a particularly sharp increase in the number of participants in Agency training courses during the last

period. As to the distribution of fellowships between programme areas, over the full period there has been a decrease in the relative share of the physical sciences and a steady increase in the share of food and agriculture; other programme areas show no major change.

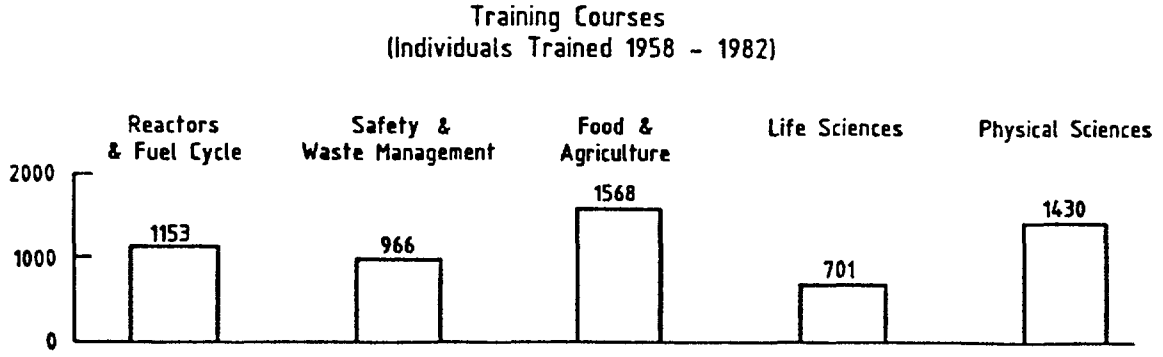
291. Training activities related to nuclear power and safety have together accounted for about one-half of the individuals trained over the past decade; this is in contrast to a share of less than 15% during the first decade. Training courses in food and agriculture, on the other hand, accounted for about one-half of the total training courses given in the first decade. For all areas, however, there was an increase in the total number of courses over the period.



292. Fellowship awards are shown by programme below. The greatest number of fellowships were awarded in the physical sciences and the lowest in nuclear safety. Of the total number, more than one-third were awarded during the last 5-year period.



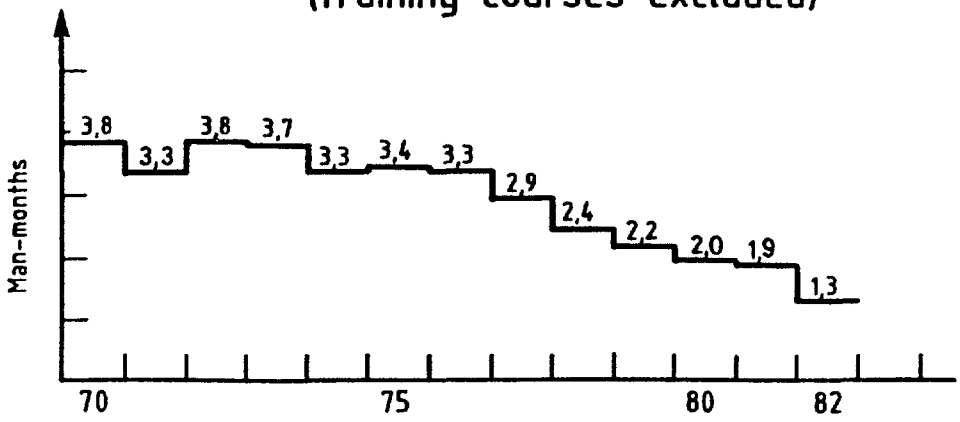
293. Below one can see the total numbers of individuals trained in courses organized by the Agency. More than one-half of those who attended courses relating to nuclear power and safety were trained during the last 5 years.

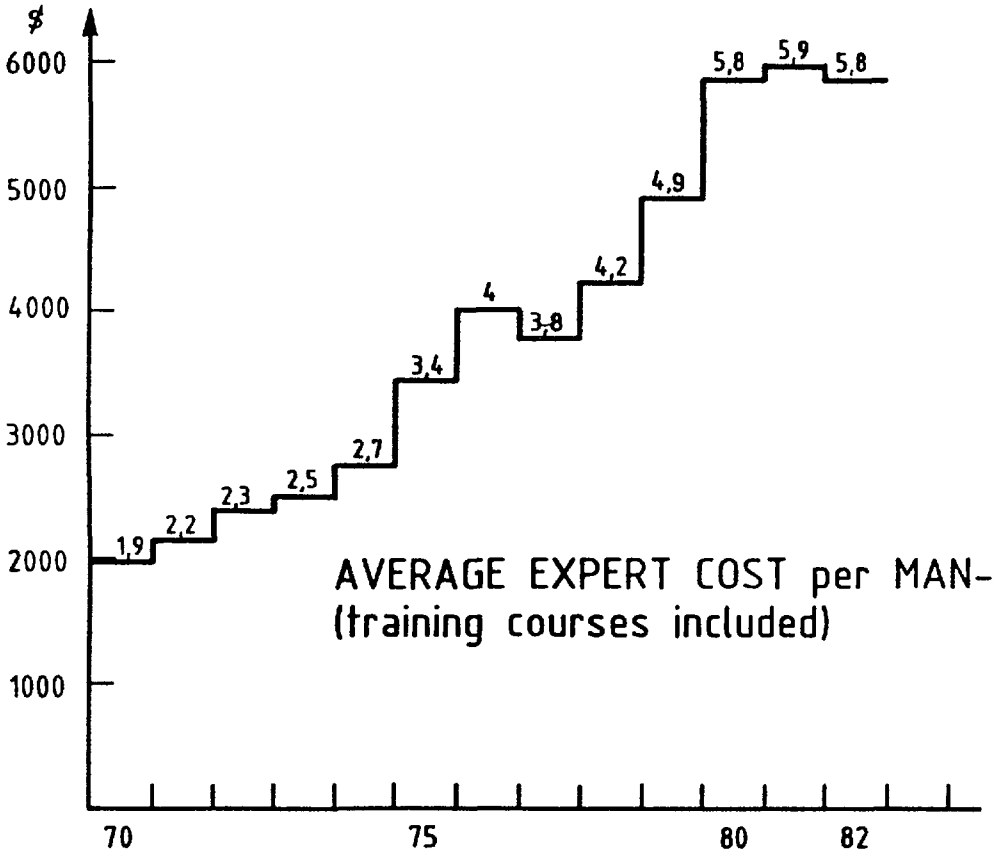


Experts

294. The relative share of expert services has been fairly stable. However, there has been a steady trend from long assignments to short consultancy-type ones, as indicated in the following chart. Member States often request highly qualified experts on very specific topics, and the recruitment of such experts tends to involve major problems and delays in the execution of projects. Also, such experts are usually not available for extended periods but only for repeated short ones (of up to one month). This leads to a higher unit cost for expert services, in addition to the fact that the fees for such experts tend to be higher. In order to meet Member States' requirements in a cost-effective manner, an increasing number of short assignments are being undertaken by Agency staff members; in 1982, about one-third of all expert assignments were carried out by Agency staff. A fairly new feature in the provision of specialized expert services is sub-contracting, whereby the Agency has on occasion obtained such services through commercial firms. Despite the difficulties encountered, however, the Agency has normally succeeded in finding the highly qualified persons required.

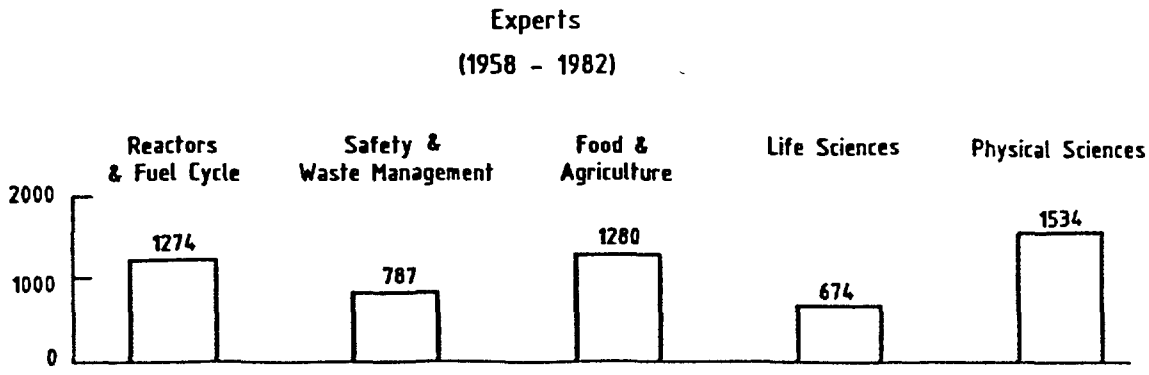
AVERAGE LENGTH OF ASSIGNMENT
(training courses excluded)





AVERAGE EXPERT COST per MAN-MONTH
(training courses included)

295. The total number of expert assignments over the period, by division, is shown below.

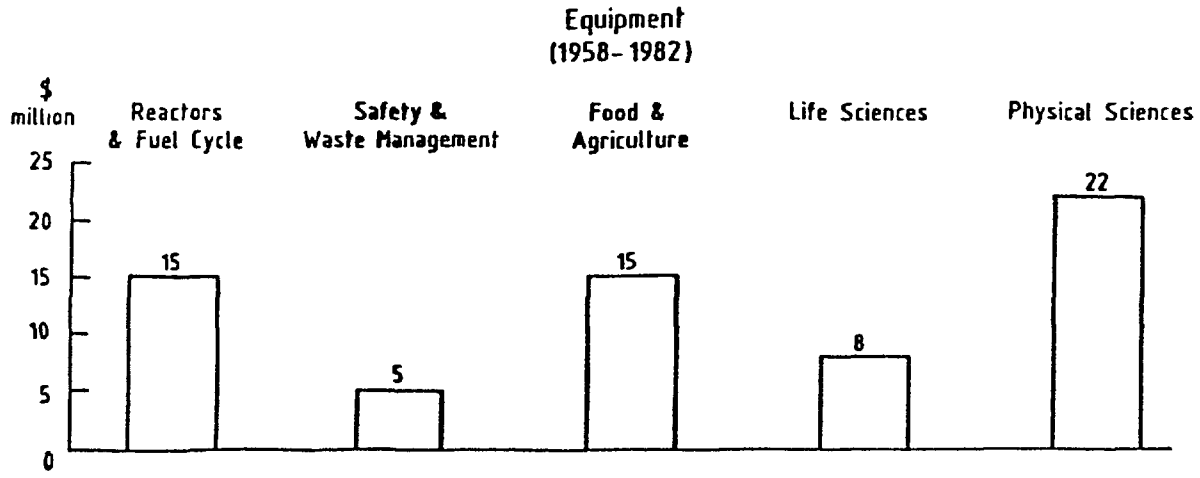


Equipment

296. In the early years, equipment was normally supplied in conjunction with the visit of an expert. With time, however, the provision of equipment alone came to be approved more frequently;[26/] this has been the case particularly with footnote-a/ projects. As a result, the share of equipment in relation to other components has increased. This trend has been reinforced by the policy - developed some years ago - of using non-convertible currencies for the purchase of very large items of equipment.

297. The total expenditure on equipment is shown in the following diagram. The most recent 5-year period accounts for a substantial portion of this expenditure. The heaviest expenditures were incurred in relation to nuclear power and the fuel cycle, food and agriculture, and the physical sciences.

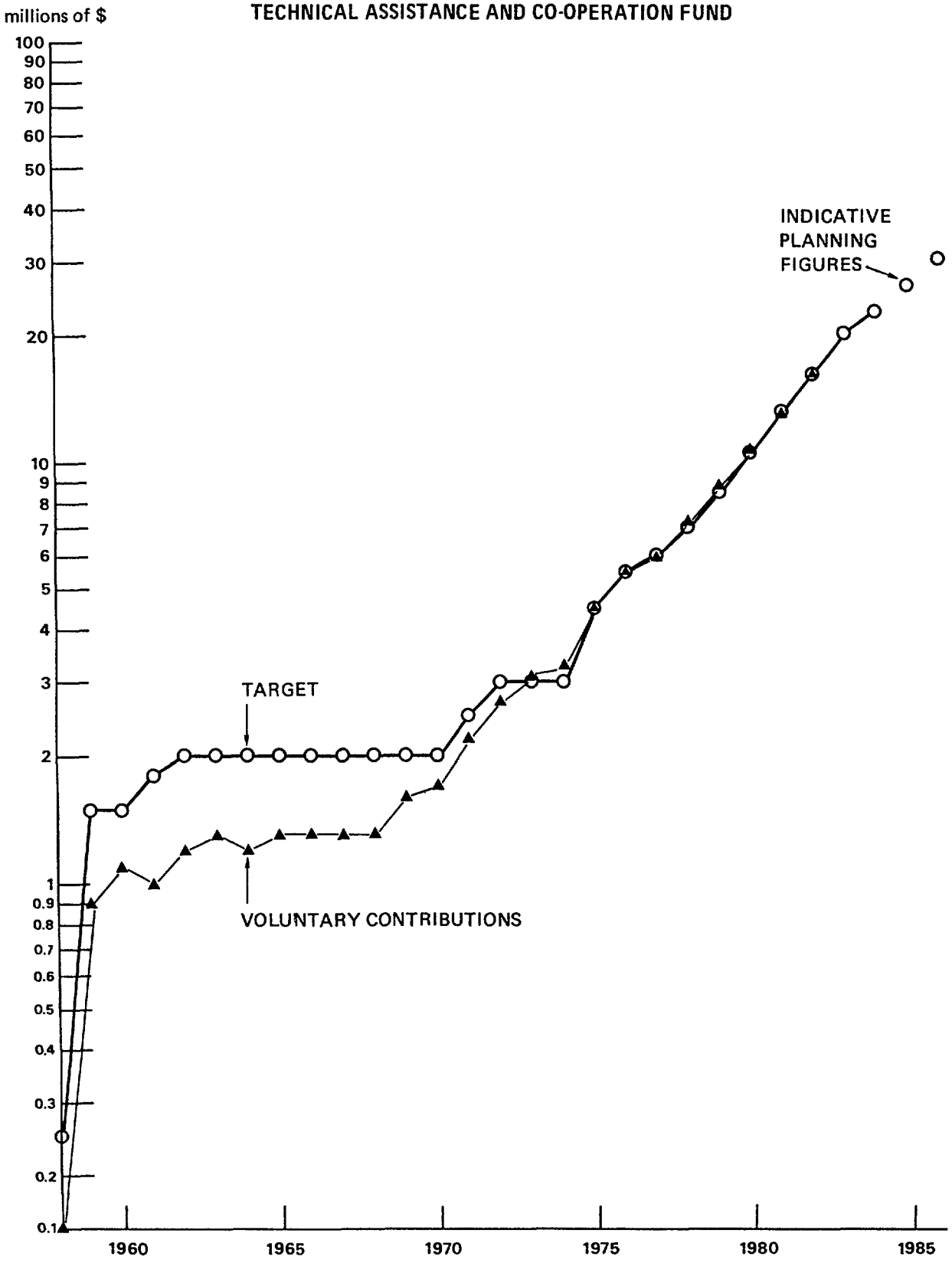
26/ See GC(IV)/RES/64.



298. Two further features of the purchase of equipment for technical co-operation purposes may be worth noting here: a small number of purchase orders are now being placed for items of very high cost (in some cases of the order of $ 1 million); and an increasing number of orders are for small, expendable items such as chemicals and glassware. However, the average value of purchase orders remains at a little below $ 5000.

Distribution of Technical Co-operation Resources

299. The number of countries benefiting from technical co-operation activities has increased rapidly. In 1958/59 about 30 countries requested Agency assistance; by the early 1980s, more than 90 countries had received assistance under the Agency's technical co-operation programmes, for a total of $ 150 million. Total voluntary contributions received for the Technical Assistance and Co-operation Fund over the period, in relation to the annual target figures, are shown in the following chart.

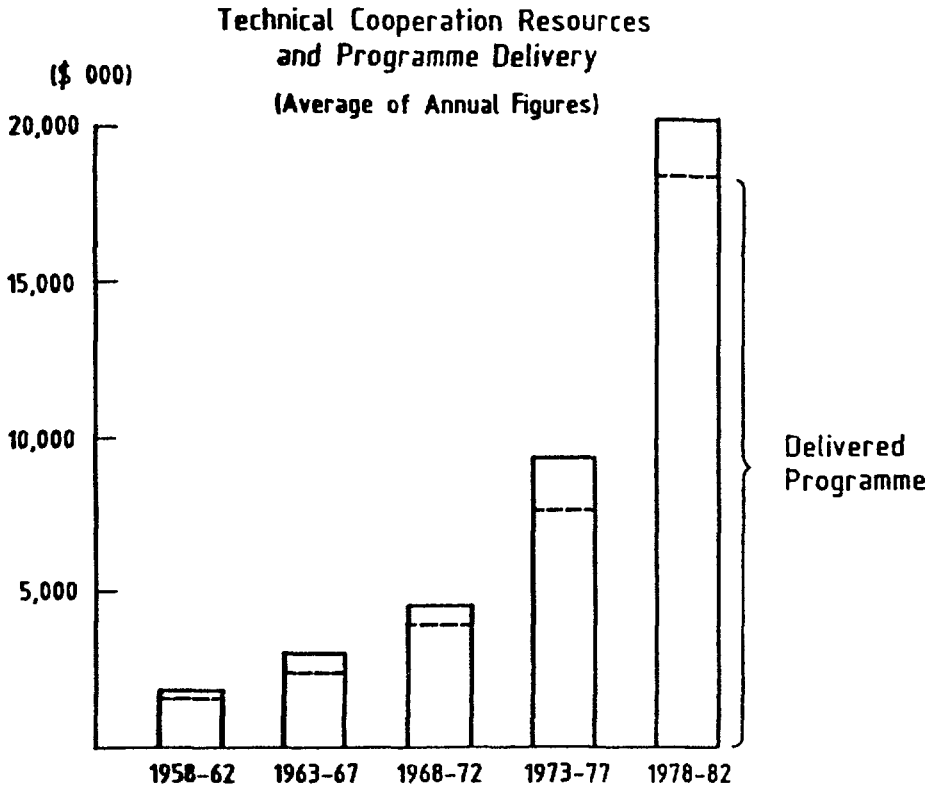

millions of $
TECHNICAL ASSISTANCE AND CO-OPERATION FUND
100
90
80
70
60
50
40
30
20
10
9
8
7
6
5
4
3
2
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
INDICATIVE PLANNING FIGURES
TARGET
VOLUNTARY CONTRIBUTIONS
1960
1965
1970
1975
1980
1985

300. The growth in resources for technical co-operation was relatively slow until the end of the 1960s.[27/] The $ 5 million mark was passed in 1972 and the $ 10 million mark about five years later. Technical assistance to a value of more than $ 20 million was delivered in 1982. At the same time, there has been some diversification in funding; besides contributions to the Technical Assistance and Co-operation Fund (previously General Fund) and resources provided by UNDP (previously EPTA and Special Fund), the Agency receives considerable - and increasingly important - extrabudgetary and in-kind contributions. In 1976 the first footnote-a/ projects were introduced into the Agency's annual programme; these are requests for technical assistance for which no immediate financing is available and for which the Agency attempts to obtain financing, on a case-by-case basis, over and above the contributions to the Technical Assistance and Co-operation Fund. In the 1983 programme, the value of footnote-a/ projects alone is $5 million. Between 70% and 80% of footnote-a/ projects have been made operational.

301. An innovation which may prove useful and attractive is the offering of pre-designed projects in selected fields. Such "packaged projects", if properly designed, could lead to more efficient utilization of the Agency's resources and to higher quality and greater impact of the Agency's technical co-operation activities.

302. The moderate growth of technical co-operation resources in the first three 5-year periods was followed by a decade of continuing increase at a much higher rate. The growth pattern is shown in the following diagram, which also shows the delivered programme. In absolute terms, the gap between delivered programme and resources available has remained fairly stable during the two most recent 5-year periods; as a percentage of the total resources available, however, the gap decreased by more than half during the last period.

27/ A period of stronger growth began in the early 1970s, with the target amount generally having been met from then on.



303. At the outset the financing of the Agency's technical assistance programme was based on purely voluntary contributions which reached a level of about one-half of the target set for each year by the General Conference . In 1961 a resolution was passed by the General Conference whereby the Member States were invited to contribute at least the same percentage of the target as their assessed contributions to the Regular Budget.[28/] During the following years the contributions increased somewhat, reaching the level of some two-thirds of the target.

28/ See GC(V)/RES/100

304. In 1962 the General Conference requested the Board of Governors to study the question of financing all the Agency's activities from a single assessed budget.[29/] A proposal to this effect was prepared and presented to the General Conference in 1963.[30/] The proposal was not adopted, however, and the Board of Governors was requested to continue its studies.[31/]

305. The matter was again taken up in 1973 when the General Conference requested the Board of Governors to study the possibilities and implications of all modes of financing the provision of technical assistance, including financing from the Regular Budget. The deliberations of the Board of Governors led to the establishment in 1980 of indicative planning figures to cover a 3-year period, which practice has been continued.

306. In 1981, the General Conference (by resolution GC(XXV)/388, adopted by consensus) requested the Board of Governors to:

> "(1) Take the necessary measures so that technical assistance is funded through the Regular Budget of the Agency or through other comparably predictable and assured resources", and to
>
> "(2) Take appropriate steps so that technical assistance funds are increased in order to respond adequately to meet increasing financial requirements for the maximum possible number of technically sound projects and to enable progress in technical assistance to keep pace with the progress in other main activities of the Agency."

29/ See GC(VI)/RES/123

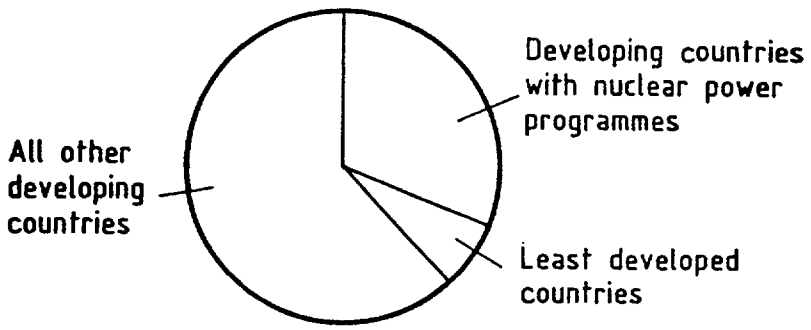
30/ See GC(VII)/236

31/ See GC(VII)(RES/143 and GC(VIII)/270 para 6.

307. In referring to the developing countries, it is often necessary to make distinctions. For the Agency's purposes it makes sense to divide developing countries into three categories: developing countries which have become industrialized to the extent that one or more nuclear power plants are under construction or in operation (there are at the moment 14 Member States in this category and the number is likely to increase in the near future); the least-developed countries (LDCs, as defined by the General Assembly), where nuclear activities in the immediate future will consist mainly of training in and the introduction of various applications of nuclear techniques; and all other developing countries, which are relatively advanced in some sectors and less so in others.

308. As can be seen from the following diagram, about 7% of the total assistance provided in 1981-82 went to LDCs, 31% to developing countries with nuclear power programmes and 62% to developing countries in the intermediate category. About 42% of the assistance provided was in relation to applications of nuclear techniques, 34% to nuclear power and safety and 24% to the physical sciences.

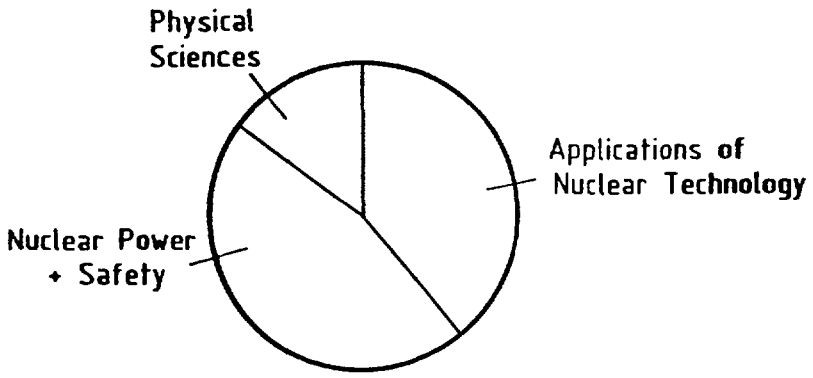
Distribution of Technical Cooperation Expenditures, by category of Developing Countries (1981 - 1982)



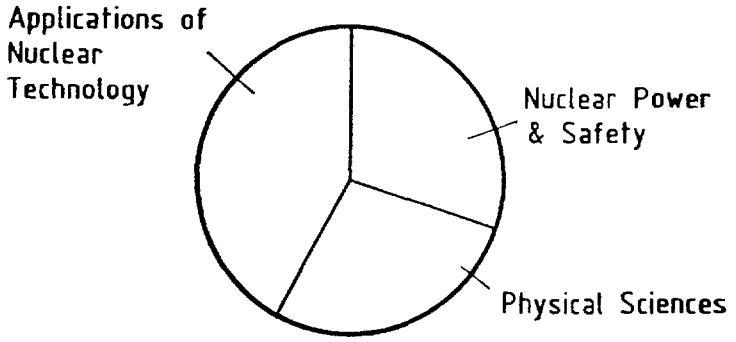
309. The distribution of funds by subject between the three categories is shown for 1981-82 in the following diagrams. As might be expected, assistance in relation to nuclear power and safety was highest in the case of countries with nuclear power programmes, while the largest share of assistance in relation to applications of nuclear technology went to LDCs. All three categories received considerable assistance in relation to the basic sciences.

Distribution of Technical Co-operation Expenditures,
by Subject, between Categories of Developing Countries
(1981-82)

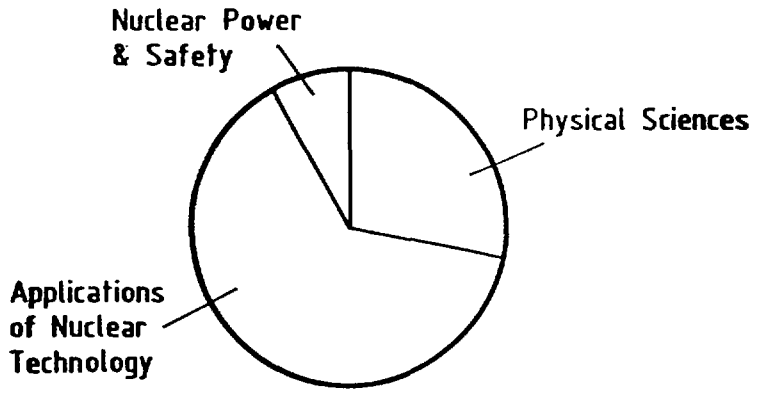
Developing Countries with Nuclear Power Programmes



All Other Developing Countries



Least Developed Countries



B) Advisory Missions

310. Advisory missions, which have been a valuable means of assisting Member States in connection with problems relating to the uses of atomic energy, consist of Agency staff members - sometimes accompanied by external experts - who visit countries for periods of up to about three weeks. Mission members give advice in an individual capacity and the Agency does not assume any commitments. Additional assistance may be provided through follow-up missions or the provision of experts for longer periods.

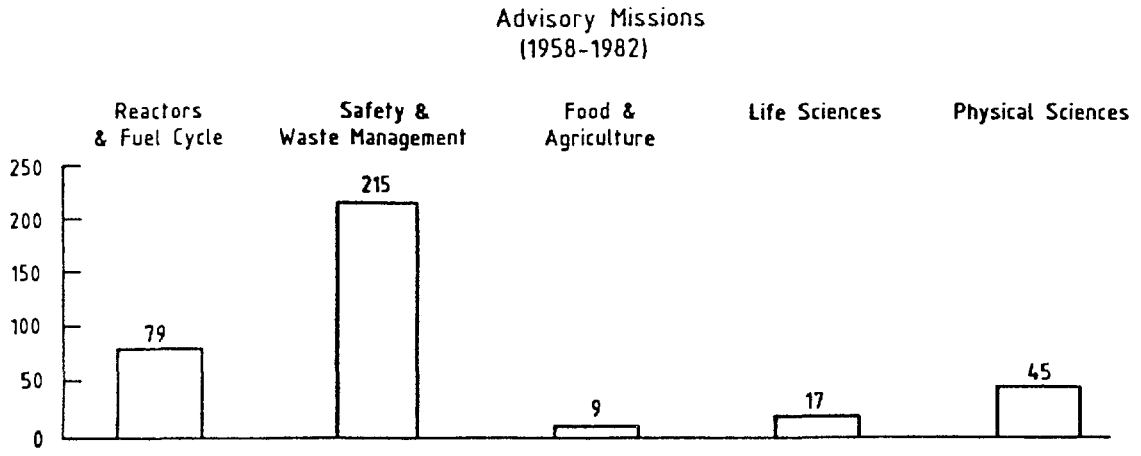
311. Such missions have been sent to many developing countries, which appreciate advice based on a variety of experiences and practices - impartial advice which may not be otherwise available. Although they have been sent by different Departments of the Agency, most of them have dealt with problems in the field of research reactor and power reactor safety, with the problems of launching nuclear power programmes and with legal aspects of the use of atomic energy. An important multi-purpose mission laid the ground for a number of activities being carried out under RCA.

312. The Agency has statutory safety responsibilities for the projects which it assists. The assistance, spelled out in a Project Agreement, usually covers the transfer of nuclear fuel or components from a supplier country to a recipient country with the Agency acting as an intermediary. The Agency has the right to require observance of and verify compliance with applicable safety standards and to call for corrective action where necessary. Safety missions, in preference to safety inspections, have been used to emphasize the Agency's basic interest in providing safety advice to its Member States.

313. A wide range of developing countries benefited from the early missions on isotope applications; subsequently, advisory missions were usually concerned with safety and benefited mainly those developing countries which were more advanced in nuclear technology. Recently, advisory missions on subjects other than nuclear safety are again being organized, and this is likely to continue, as is the use of

multi-disciplinary missions from time to time in support of efforts at more integrated programming - particularly on a regional or sub-regional basis.

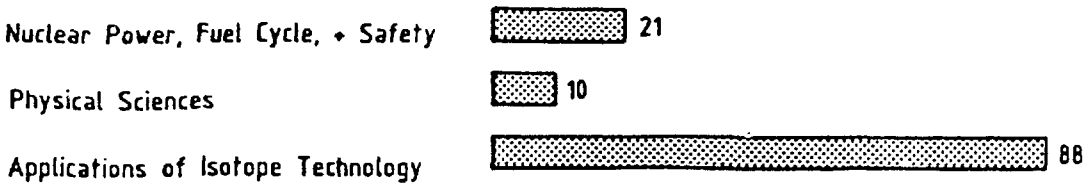
314. As can be seen from the following chart, by far the greatest use of advisory missions has been made in nuclear safety and relatively little use has been made of them in relation to isotope and radiation applications.



C) Research Contracts and Agreements

315. Research contracts and agreements have become an important mechanism in the Agency's efforts to transfer nuclear science and technology. Three-quarters of all research contract funds available over the past decade have been awarded to institutes in developing countries, and these institutes are now participating in work on every subject covered by the research contract programme. In most cases they participate in co-ordinated research programmes, which provide opportunities for continuing and direct contact with peer groups working in the same field. Nearly 120 such programmes had been completed by the end of 1978, some three-quarters of them in the field of isotope and radiation applications, as is shown in the following chart. Over 30 research co-ordination meetings are held each year.

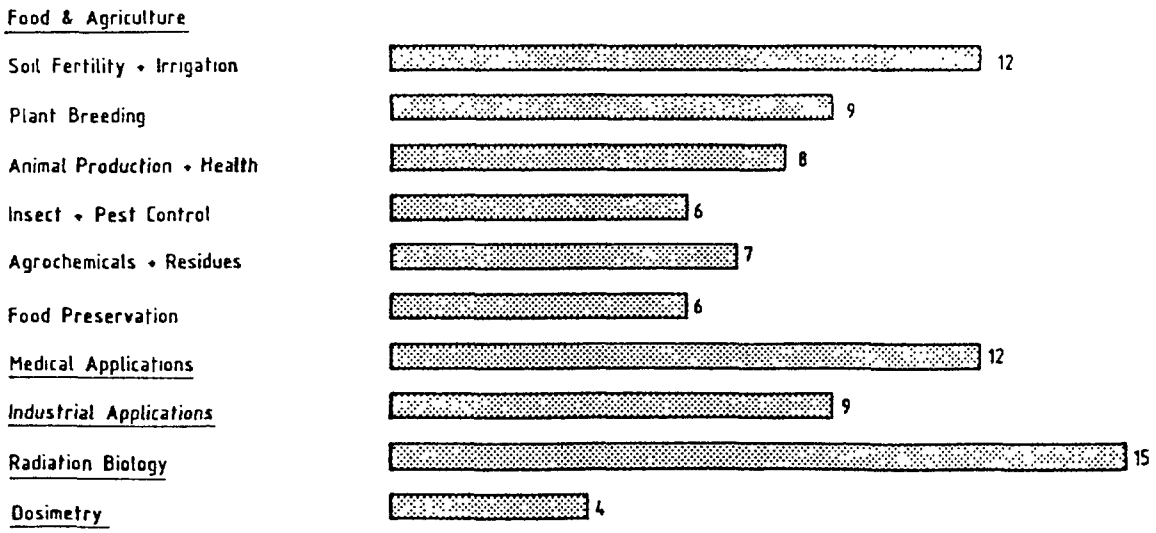
Completed Coordinated Programmes of Research (All Subjects)*



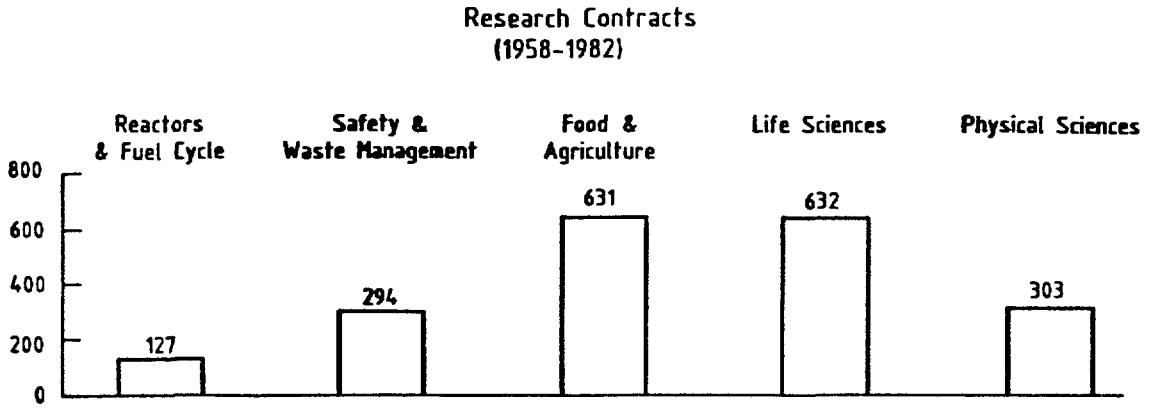
* 3 programmes have been completed as well in the field of Safeguards.

316. Of the programmes relating to isotope technology, more than half were in the field of food and agriculture and many in the fields of medical applications and radiation biology. The distribution is shown in the following chart.

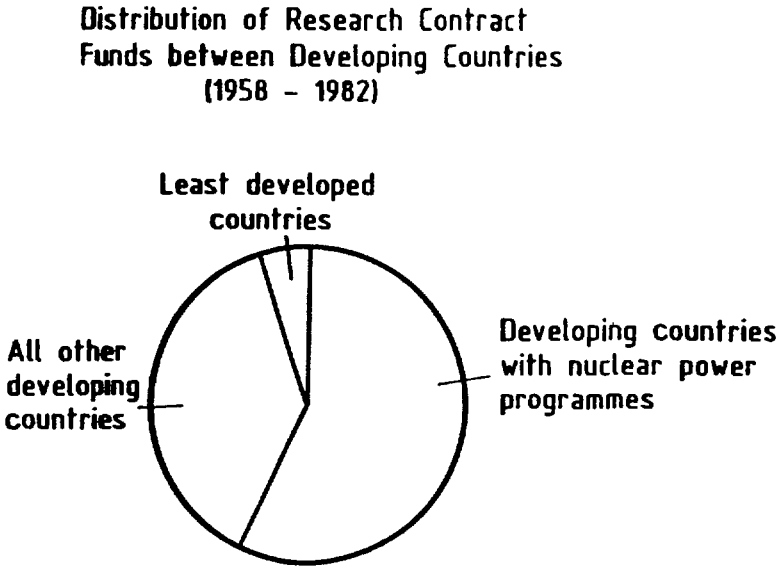
Completed Coordinated Programmes of Research in Applications of Isotope Technology



317. As is evident from the following chart, the programme activities which have made the greatest use of research contracts over the past 25 years have been food and agriculture and the life sciences. The least number of awards have been made in relation to nuclear power and the fuel cycle.



318. The distribution of research contract awards among the three groups of developing countries over the 25-year period is shown in the following diagram.



319. Research subjects are as a rule oriented very much towards the needs of developing countries, and, other things being equal, preference in making awards is given to institutes located in these countries.

320. The Agency acts upon applications received directly from research institutes, the Member State concerned simply being kept informed, so that projects are often initiated very quickly - within a period of three to four months. The current award rate for new contracts is of the order of 150 a year.

321. The Agency will continue to use research contracts to support activities involving isotope applications in 40-50 developing countries at widely differing stages of advancement, while support for activities in other fields will tend to be directed to those developing countries which possess the most advanced research facilities.

D) Regional Co-operation Activities

322. A sustained effort at co-ordinated regional project planning and implementation was initiated in 1972 through conclusion of the Regional Co-operative Agreement (RCA), and the example of RCA is currently being examined with a view to the conclusion of a similar agreement for Latin America.

323. The purpose of the RCA arrangements is to promote and co-ordinate research, development and training projects in nuclear science and technology through co-operation between national institutions and with the Agency's assistance. The implication is that all mechanisms available to the Agency for the support of such activities may be employed, and in fact a number of projects have been supported through research contracts and use of the traditional technical assistance mechanisms, and funding - over and above the sums made available by the participating Member States themselves - has been provided by donor States within the region (one of them a developing country), by UNDP and from the Agency's Regular Budget.

The large-scale UNDP project being executed within the framework of RCA has required substantial co-ordination of planning between the participating countries themselves, and it is expected that the pattern established for closer co-operation at both the planning and the implementation stage will serve for other activities.

324. The underlying policies are to foster self-reliance in each of the participating countries, to support activities in nuclear science and technology that it is believed will yield the highest social or economic benefit, and to utilize existing arrangements and facilities to the maximum extent possible rather than creating new ones.

325. Regional priorities in the following areas are considered to be the most important: manpower development; the acceptance of modern technology; food production; development of natural resources; energy and raw materials savings; and social needs (including health care, employment and environmental quality).

326. Considerable stress is laid on horizontal co-operation both within and between countries, and provision for regular meetings of scientists and administrators has been institutionalized. This is in line with the TCDC concept.

327. While it is somewhat early for a full evaluation of the arrangements, the results after a decade are encouraging: a heightened sense of regional awareness has developed, the high visibility of the projects at the local level has led to strong support (countries more advanced in a particular field are helping countries which are less advanced), there is a high potential for attracting funds from organizations, agencies and Member States, and the multiplier effect for Agency expenditures is therefore high.

328. A particularly attractive aspect of such arrangements is that, as all mechanisms can be employed, one is not restricted to narrow subjects where only one particular mechanism is appropriate.

E) Codes and Guides

329. From the beginning the Agency has served as a focal point for an international exchange of information on all subjects related to nuclear energy. Also, its Statute gives it a mandate to develop international nuclear safety standards. Lastly, the Agency is enjoined to bear in mind the special needs of the developing areas when it is allocating its resources.

330. A recent feature of the Agency's activities in the safety standards area has been the efforts to assist Member States in implementing the NUSS codes and guides, the Basic Safety Standards for Radiation Protection and the Regulations for the Safe Transport of Radioactive Materials.

331. Under the NUSS programme, agreement has been reached on the need for regulatory organizations that will ensure that nuclear power programmes are conducted properly, on the requirements which such organizations must meet, and on such matters as the information that must be provided and investigations that must be carried out in nuclear plant siting studies.

332. The Agency's standards are not a substitute for industrial codes, in which procedures are specified in minute detail; but they are complementary to them, and they can be of particular value in developing countries where equipment and services are obtained from several countries which may not share the same standards.

333. Although there are no plans at present for formalizing the NUSS codes and guides in an international convention, considerable effort is being devoted to encouraging their use. Training courses and seminars are being organized to promote them as a basis for preparing national regulations, for developing national nuclear industries and for participating in international nuclear commerce. The Agency is arranging visits to Member States by experts who have been directly involved in the preparation of these documents, during which discussions can be held with regulatory, utility and other personnel.

Such missions should be particularly useful to countries in the early stages of nuclear power programmes. So far, 14 countries have requested missions; five had been completed by the end of 1982.

334. Through the adoption of the Agency's Regulations for the Safe Transport of Radioactive Materials and their world-wide application, a high standard of safety has been provided for. The Regulations have been incorporated into the rules of nearly all international transport agencies, including the International Maritime Organization (IMO, formerly IMCO), the International Air Transport Association (IATA), and the Inland Transport Committee of the Economic Commission for Europe.

335. Like the Basic Safety Standards for Radiation Protection, the Regulations need to be revised at suitable intervals. An updated version is planned for 1984, marking roughly a decade since the current version was issued. Meanwhile, Member States are being assisted in implementing the Regulations and in ensuring compliance with them. Advisory missions are available, and a training course for personnel from developing countries was held in 1982. Also, a guidebook on quality assurance and other explanatory documents have been prepared.

336. During the past few years the nuclear safety role of the Agency has grown. Now, it is of vital importance to encourage the use of the results of Agency activities. The Basic Safety Standards and the NUSS codes and guides have been developed with the active participation of Member States, and their contents should be fed back to industry, government and utilities in these countries. A continuing theme for the future will be to assist Member States in implementing the guidance which has been developed.

F) CAS

337. The work of CAS has been described in CAS's reports to the Board of Governors.[32/]

G) Information Exchange and Dissemination

INIS

338. INIS has from the outset co-operated with other information systems and related organizations. For example, it assists the NEA Data Bank in the testing and distribution of computer programs to Agency Member States, it has an agreement with UNESCO concerning the use of Agency information-handling software (Integrated Set of Information Systems) by INIS members, and INIS staff have participated in the work of the Abstracting Board of the International Council of Scientific Unions and of various subcommittees of the International Standards Organization.

339. The subject scope of INIS includes virtually every aspect of the peaceful uses of nuclear science and technology. INIS members are responsible for submitting records on all literature within this subject scope which is issued within their jurisdictional boundaries. It is estimated that the resulting body of literature represents at least 95% of world publications on nuclear science and technology. The data base now contains about three-quarters of a million records and is growing at a rate of about 75 000 records a year.

32/ GOV/2012 (first session), GOV/2024 (second session), GOV/2045 (third session), GOV/2061 (fourth session), GOV/2081 (fifth session), GOV/2103/Rev.1 (sixth and seventh sessions), GOV/2123 (eighth session, together with a report on the first eight sessions), GOV/2141 (ninth session, together with a report of Working Group 2 entitled "IAEA system for an emergency and back-up mechanism" and GOV/2147 (tenth session, with an Annex entitled "Conclusions of CAS on revision mechanisms". The status of discussions on "Principles of international co-operation in the field of nuclear energy in accordance with the mandate of the Committee on Assurances of Supply" is reflected in working paper CAS/S.11/W.P.1.

340. The system produces twice a month magnetic tapes which contain bibliographic descriptions, subject indexing and abstracts for all documents reported to it; it also produces a twice-monthly abstract journal entitled "INIS Atomindex". Thus, INIS provides Member States with a comprehensive tool for current awareness of progress in nuclear science and technology as reflected in the literature. The system also assures convenient access to the full texts of so-called "non-conventional" literature (technical reports, conference preprints, patent specifications, theses, etc.) through the sale of microfiches (card-size sheets of film containing up to 96 pages of text each) prepared by the INIS Clearinghouse and made available to Member States both on a subscription basis and by individual order. Through the INIS training programme, the staff of information centres in Member States are trained in the most up-to-date techniques of information handling.

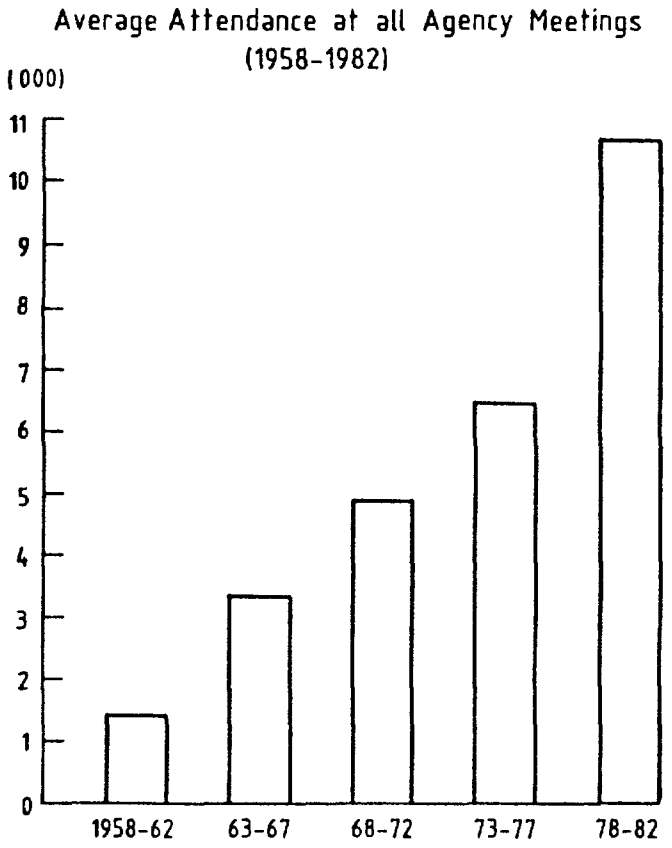
341. INIS has made substantial efforts for many years to ensure that developing countries participate as fully as possible in providing input and drawing upon the services available. The printed version of the INIS data base, "INIS Atomindex", specifically for the use of those INIS members which do not have access to a computer. When telecommunication facilities and funds are adequate, however, institutions in developing countries can also query the data base directly on the Agency's computer, and many are doing this. Telephone and mail enquiries are received at a rate of some 70 a month. In addition, to make it easier for developing countries to acquire technical reports and other documents not readily available commercially, the INIS Clearinghouse provides them with microfiches at specially reduced prices.

342. Apart from the services available in Vienna, national information centres are active in 35 developing Member States. The Agency advises and assists the staff of these centres in connection with the compilation, storage and dissemination of information, and training has been given to 220 of them over the years in 33 training seminars.

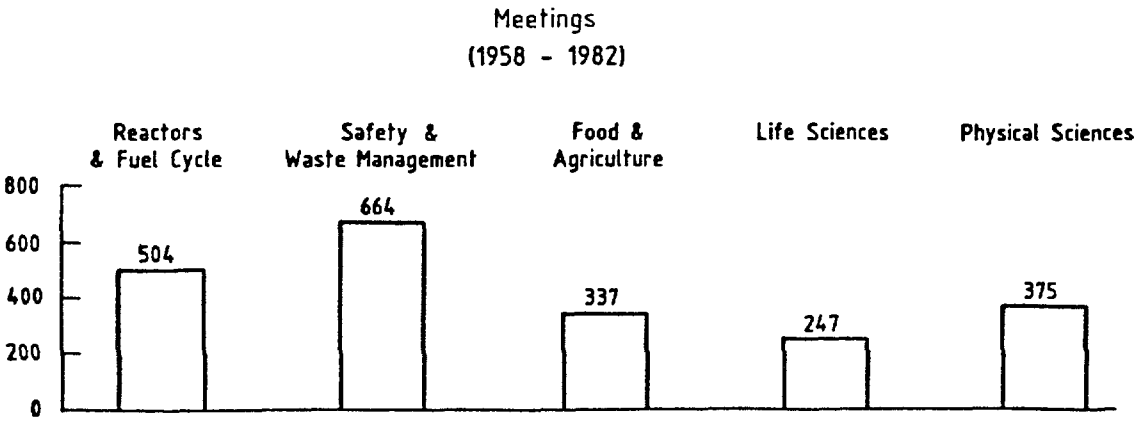
Meetings

343. One of the Agency's principal mechanisms for exchanging information continues to be meetings; some 20 conferences, symposia and seminars and about 190 smaller meetings are organized each year. The number of participants in Agency meetings over the 25-year period is shown in the following diagram.

344. In order to ensure the presence of participants from developing countries at larger meetings, provision was introduced some years ago for partial or full funding of the attendance of selected participants. Over the past 5 years, an average of 500 participants a year from developing countries have attended Agency conferences, symposia and seminars.



345. The numbers of meetings of all categories held in connection with the various programmes are shown below. About one-half of all meetings related to reactors and nuclear safety.

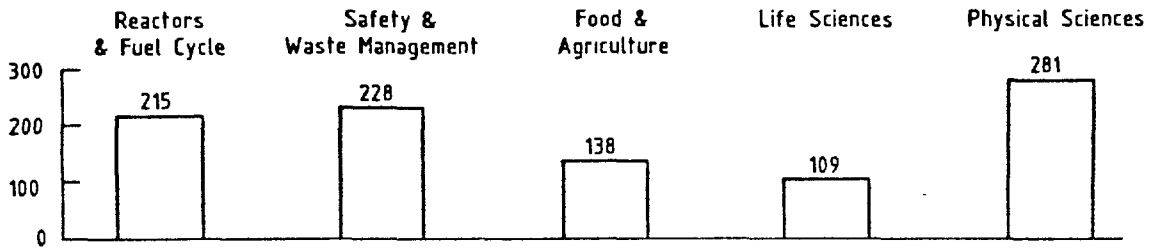


Publications

346. The Agency has been publishing material on nuclear science and technology subjects since 1958 and has been printing its own publications since 1962. In 1982, about 50 000 pages of scientific material were published by the Agency, about half of it accounted for by INIS publications. About half of the scientific publications are distributed to Member States free of charge as a service rendered by the Agency; the rest are sold. Sales proceeds in 1982 amounted to $1.2 million.

347. Publications relating to the various programmes are shown below for the 25-year period.

Publications
(1958 - 1982)



Nuclear Data

348. Over the years, the Agency has built up a centre providing - inter alia - nuclear data, computer codes for nuclear data processing and nuclear data expertise. As a result, a number of research groups at laboratories and universities in developing countries have developed their own capability for measuring, calculating, analysing and processing the nuclear data required for the development of nuclear science and reactor technology in their countries.

349. The centre supports and co-ordinates an East-West and North-South exchange among nuclear centres covering the systematic collection, evaluation and dissemination of nuclear and atomic data.

In addition, the Agency's nuclear data programme:

- serves as a focal point for the transfer of methods and techniques to developing countries;
- provides nuclear data for high-priority fields such as nuclear safety, safeguards and fusion;
- serves as a centre of research co-ordination by assessing the needs for nuclear data in various fields, by supporting laboratories in developing countries in the measurement and evaluation of data, and by generating standardized nuclear data for the benefit of all Member States; and
- serves as the principal international centre for the production and dissemination of nuclear data publications distributed to more than 4000 scientists in all Member States.

350. Today the Agency provides cost-free data centre services to more than 1700 scientists in 60 developing Member States, co-operates with national and regional data centres in the systematic world-wide collection, compilation, dissemination and exchange of nuclear reaction and nuclear structure and decay data and offers atomic and molecular data services for fusion technology.

351. The nuclear data and computer codes provided by the Agency, complemented by technical co-operation projects for the transfer of expertise in nuclear data measurement techniques and instrumentation,

are contributing to the development of scientific infrastructures and strengthening the ability to perform accurate nuclear measurements in recipient countries, thereby enhancing the quality of their research.

Library

352. Member States are entitled to use the VIC Library, which serves the Agency and the other Vienna-based organizations belonging to the United Nations system. The Library has a combined collection of about 60 000 books and takes about 4000 periodicals. Over 400 000 technical reports are available on microfiche and 100 000 in hard copy. Also, the Library holds approximately 300 films dealing with the peaceful uses of nuclear energy and maintains an almost complete set of United Nations documents.

353. Library services consist of reference and loan services, photocopying, a film loan service and computer-based information services.

H) Funding

354. The Secretariat arranges for the funding of activities considered to be of greatest interest to its developing Member States by:

- employing its own resources, received in the form of assessed and voluntary contributions;
- making use of funds and in-kind donations received from countries or other organizations; and
- serving as an intermediary between donor and recipient States.

355. Activities of relevance to this process include:

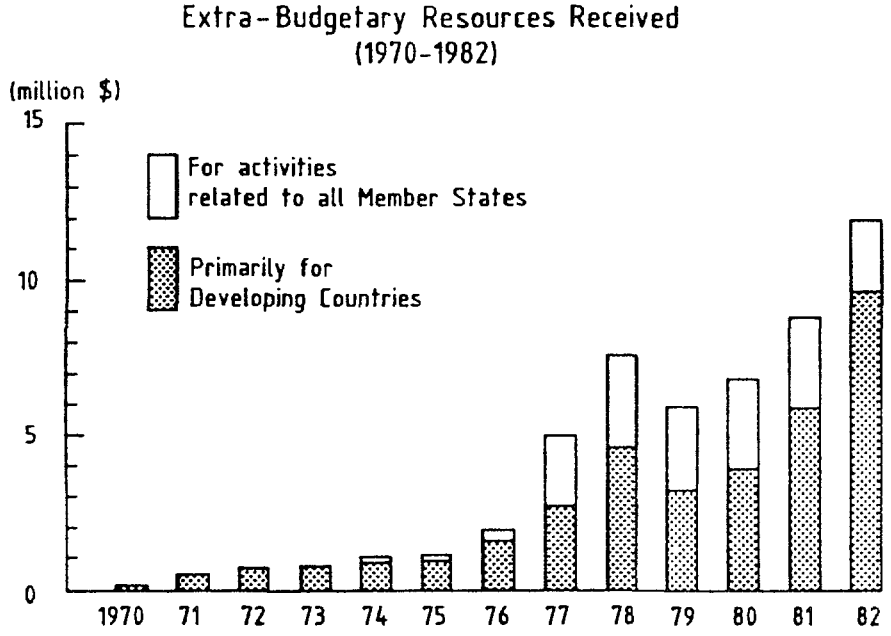
- financial planning for projects and other activities;
- fund-raising;
- the administration of expenditures, record-keeping and the preparation of financial statements.

356. The financial procedures are much the same whether the Secretariat is acting in respect of its own, in-house activities or of projects to be carried out in Member States. What varies is the extent to which the Secretariat may engage in external fund-raising, which may of course be engaged in independently of the budgeting process.

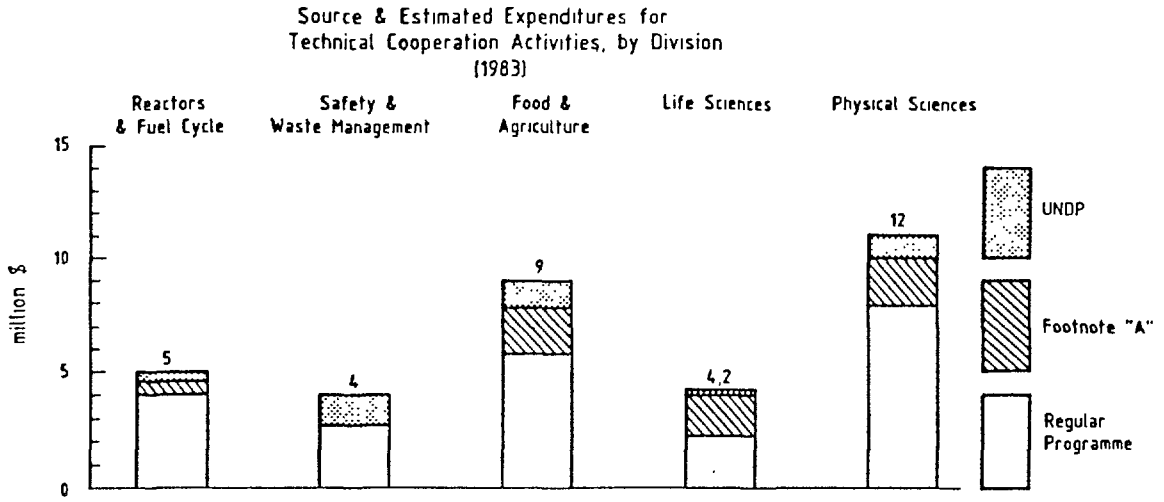
357. Critical to the process is the extent to which financial requirements are adequately identified, a source (or sources) of funds found, and an appropriate cash flow maintained to cover the expenditure pattern necessitated by the activity.

358. As far as the rules and regulations for managing the Agency's financial activities are concerned, there is a substantial degree of flexibility in the use of available funds thanks to the Director General's authority to make budgetary transfers and to the possibility of requesting the Board to authorize larger redistributions of funds. While some restrictions are inherent in any process of annual appropriations, it does not appear that the financial procedures have had a negative impact; in fact, they make an automatic review mandatory, thus providing a useful opportunity for identifying such corrective action as may be required. Furthermore, it has proved possible to develop a number of multi-year programmes in various fields without difficulty. Broadly speaking, the financial arrangements required for the type of activities carried out to date have been and will probably continue to be sufficient. This says nothing of expanded fund-raising efforts, however, which are a different area of activity.

359. Over the past decade a substantial effort has been made to obtain supplementary outside funding for various activities. The results achieved are shown in the following chart. At the current level, such contributions add something of the order of 10% to the annual budget, and over the past 5 years two-thirds of the amount received was provided for activities of greatest relevance to the developing countries.



360. The current level of resources for technical co-operation activities is shown, by programme and source, in the following chart.



I) Laboratory Services

361. The Laboratory has contributed directly and in several ways to increases in the competence of laboratories in a number of developing countries: Laboratory staff members have undertaken technical co-operation assignments, back-up services have been provided for co-ordinated research programmes, and scientists and technicians have been trained. The Laboratory now offers 6-week training courses in plant breeding and in soil fertility work.

362. Techniques using radioisotopes or radiation continue to play an important role in the Laboratory's programmes, and trainees are taught to use the technique most suited to the problem in hand and to the available equipment and experience. With the most modern analytical methods, properties such as the mass difference of stable isotopes or orbital characteristics are often used in order to ensure high sensitivity and accuracy.

363. The Laboratory continues to give advice on the establishment of analytical and other facilities at laboratories in developing Member States and to assist such laboratories through the provision of quality control, intercalibration and other services.

J) Collaboration with Other Organizations

364. Besides the very close collaboration with FAO regarding the work of the Joint FAO/IAEA Division and with UNESCO regarding that of the International Centre for Theoretical Physics, the Agency collaborates through liaison groups with WHO and WMO; regular consultations take place with the former on the Agency's activities in the life sciences and food irradiation and with the latter on the Agency's activities in isotope hydrology. Also, the Monaco Laboratory maintains continuing contacts with the Intergovernmental Oceanographic Commission (UNESCO), UNEP, IMO and FAO.

365. The Agency also maintains working contacts with multinational organizations outside the United Nations family. For example, it co-operates with NEA/OECD in nuclear safety, waste management, fuel cycle and uranium resources matters and maintains working contacts with CMEA regarding these topics.

366. Working contacts with EURATOM relate to implementation of the safeguards agreement between the Agency, EURATOM and the latter's non-nuclear-weapon member States and to nuclear safety, safeguards research and development, nuclear information (INIS) and fusion research (INTOR).

367. Periodic contacts continue with IANEC, and co-operation with this organization is likely to increase if an agreement along the lines of RCA is concluded for Latin America. Also, the Agency liaises with OPANAL in relation to the negotiation of safeguards agreements with countries party to the Tlatelolco Treaty.

IV. CONCLUSIONS

A) Programmes

368. Many of the Agency's activities are heavily oriented towards the requirements of developing countries. Also, some activities - such as INIS and the activities connected with nuclear safety - relate to the foundations on which any nuclear programme must be built and are therefore of interest to all Member States. Different groups of countries are assisted in different ways, and there appears to be a relationship between the extent of a country's nuclear development and the extent to which the Agency has been able to assist it. Further, as has been noted, safeguards concern all Member States as they form the basis for verifying the peaceful nature of nuclear activities and giving an assurance which is vital to the further development of nuclear science, technology and trade for peaceful purposes.

369. It is difficult to conceive of additional programme activities in which the Agency might legitimately engage and which would prove of clear benefit to one or more of the three categories of developing Member State considered in this review. However, certain aspects of existing programmes might perhaps be further developed to the advantage of developing countries. For instance, given its expertise in the field of comparative energy analyses, the Agency might usefully become more active - possibly in collaboration with other organizations - in carrying out or assisting with such analyses for Member States which need the results in order to develop a rational and coherent energy policy. Or the Agency might perhaps do more to assist its developing Member States - particularly those with modest infrastructures for information exchange - in improving their access to information in the nuclear field and in storing and retrieving such information; such assistance would be broader than that provided through INIS, and could have an impact in other areas of importance to development.

370. With regard to radioisotope and radiation applications, the Agency is fully aware of the latest developments and is well able to assist its developing Member States. However, the techniques in question are now relatively mature, and at the same time developments have been taking place in related non-nuclear techniques. It is important that the Agency be equally aware of these developments and it might be desirable for the Agency - on a selective basis - to seek closer collaboration with organizations that are concerned with these techniques and may be considering nuclear techniques as possible aids.

B) Mechanisms

371. A sufficient variety of mechanisms appears to be available to the Agency for carrying out its tasks, and there would seem to be little value in developing new ones. The following has been what might be called the "classical sequence" in the provision of technical assistance by the Agency: - fellowship award - expert's visit - the provision of equipment - the award of research contracts. However, with the substantial development of nuclear-based technology in some developing countries this sequence is often no longer appropriate. In such cases better use could perhaps be made of the available mechanisms through a greater degree of integrated programming on the basis of national development goals which are specified at the outset and which the Agency's contributions can help in achieving, rather than programming on the basis solely of a technique or a programme mechanism. The emphasis in recent years on multi-year programming and the development of regional programmes is a step in this direction. When such goals are being established, it would be useful if Member States consulted with the Agency on how its contributions can best fit in.

372. A concept mentioned frequently of late is "package programming", whereby a programme is prepared (i.e. packaged) for possible delivery to a number of countries requiring the same type of aid for identical or similar purposes. This concept should be examined further and, where feasible, implemented on a trial basis.

373. Considerable efforts have been made in recent years to obtain extra-budgetary resources for financing programmes of benefit to developing Member States, and these efforts should continue. One way of obtaining such resources might be to prepare projects for implementation subject only to the availability of financial resources and keep such a "shelf-list" of projects for presentation to possible donor States or organizations.

374. Longer-term programming implies the need for a substantial degree of predictability as regards the availability of financial resources. Considerable progress has been made in this respect in recent years, but developing Member States still face difficulties in arranging financing for nuclear power installations. It is necessary to continue efforts to develop appropriate means at the international level for providing assistance in this area.

375. Finally, developing Member States themselves are in a position to help in many way, primarily by ensuring the fullest co-operation of all interested government departments and making the appropriate long-term commitment to projects initiated or supported by the Agency.