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List of abbreviations

Agency	International Atomic Energy Agency
CERN	European Organization for Nuclear Research
ECE	Economic Commission for Europe (of the United Nations)
ECOSOC	Economic and Social Council of the United Nations
ENEA	European Nuclear Energy Agency of the Organisation for Economic Co-operation and Development
EURATOM	European Atomic Energy Community
EXFOR	Exchange Format for Nuclear Data
FAO	Food and Agriculture Organization of the United Nations
IAEA	International Atomic Energy Agency
IBRD	International Bank for Reconstruction and Development
ILO	International Labour Organisation
IMCO	Inter-Governmental Maritime Consultative Organization
INIS	International Nuclear Information System
MHD	Magnetohydrodynamic
NPT	Treaty on the Non-Proliferation of Nuclear Weapons
NPY	Co-operative project in reactor physics under the Agreement between the Agency and the Governments of Norway, Poland and Yugoslavia
OPANAL	Organization for the Prohibition of Nuclear Weapons in Latin America
SIDA	Swedish International Development Authority
UNDP	United Nations Development Programme
UNDP(SF)	United Nations Development Programme (Special Fund component)
UNDP(TA)	United Nations Development Programme (Technical Assistance component)
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNIDO	United Nations Industrial Development Organization
UNSCEAR	United Nations Scientific Committee on the Effects of Atomic Radiation
USAEC	United States Atomic Energy Commission
WHO	World Health Organization
WMO	World Meteorological Organization

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 NOTE

All sums of money are expressed in United States dollars



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

The Treaty on the Non-Proliferation of Nuclear Weapons

1. The Board of Governors is pleased to record that much progress has been made in preparing the Agency to discharge the responsibilities devolving upon it as a result of the entry into force of the Treaty on the Non-Proliferation of Nuclear Weapons (NPT) [ 1 ] on 5 March 1970.
2. In April 1970 the Board established the Safeguards Committee (1970) to advise it as a matter of urgency on the content of the safeguards agreements that non-nuclear-weapon States party to NPT are required to conclude with the Agency under Article III thereof. In June the Board further asked the Committee to consider the problem of safeguards financing at the earliest possible moment. By 10 March 1971 the Committee had completed its work on both these matters.
3. The Committee recommended that the safeguards agreements should consist of two parts; the first should contain provisions relating to the basic legal, financial and administrative obligations of the State and the Agency, and the second should set forth in detail the technical safeguards procedures to be followed. The Director General has been authorized by the Board to use the Committee's recommendations [ 2 ] as the basis for negotiations with the States concerned.
4. On 20 April the Board endorsed a set of arrangements for safeguards financing which the Committee had elaborated, taking note at the same time of the French disagreement with them. The Board also requested the Director General to apply the arrangements in the proposals he will make to the General Conference for the assessment of contributions towards the Agency's administrative expenses in 1972.
5. The Committee also gave attention to the offers made by the United Kingdom of Great Britain and Northern Ireland and the United States of America to place certain of their peaceful nuclear activities under Agency safeguards, subject to national security restrictions. On 20 April the Board authorized the Director General to enter into consultations with the Governments of the United Kingdom and the United States as to the desirable content of the required agreements with the Agency; the consultations began in early June.
6. The Board wishes to place on record its appreciation of the achievements of the Committee in successfully accomplishing a task of great legal and technical complexity. This has enabled the Agency to enter promptly into negotiations for agreements with the non-nuclear-weapon States party to NPT, and by 30 June 1971 negotiations with 29 States were in progress. Earlier that month the Board approved the first two agreements - with Finland and Austria respectively. [ 3 ]

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[ 1 ] Reproduced in document INFCIRC/140.

[ 2 ] The material on the structure and content of agreements formulated by the Committee is reproduced in document INFCIRC/153. The main provisions are summarized in para. 117 below.

[ 3 ] See para. 123 below.

7. It is expected that the safeguards agreements to be concluded with States party to the Treaty for the Prohibition of Nuclear Weapons in Latin America (the Tlatelolco Treaty) will be essentially similar to those to be concluded in connection with Article III of NPT; many of the States concerned are parties to both treaties. As of 30 June the Tlatelolco Treaty was in force between 17 States in Latin America.

#### Technical programmes

8. For the second year in succession the resources available to the Agency's technical assistance programme have grown and the Board has again felt able to recommend to the General Conference an increase of \$500 000 in the target for voluntary contributions to the Agency's General Fund. It has not been possible to expand any other technical activities of the Agency during the year, except for those mentioned in paragraph 11 below. Indeed, for a number of years, most of the Agency's technical programmes have been maintained at constant monetary levels and, in fact, curtailed if account is taken of the shrinking real value of resources available.

9. It is clear that there will have to be a continuing and substantial growth in the scope of assistance to developing countries - through the Agency's various programmes and by other means - if the expectations aroused by Article IV [ 4 ] of NPT are to be fulfilled. It is to be hoped that the Fourth International Conference on the Peaceful Uses of Atomic Energy which will be held in September this year will give renewed impetus to this objective of NPT.

10. The International Nuclear Information System (INIS) which began operation last year, is making satisfactory progress. The joint FAO/Agency programme for the use of nuclear techniques to increase protein production can now be expanded, largely as a result of a special contribution made to it. Agreement has also been reached to establish an International Fusion Research Council.

11. Account should also be taken of resources, external to the Agency, which are available for assistance in nuclear energy. The trend in UNDP technical assistance activities in nuclear energy has been reasonably encouraging. Since 1961 the resources made available to the Agency by UNDP have increased by more than 40% and they are expected to rise by 10-15% per year for some time to come.

12. With regard to larger undertakings, the Agency is currently executing three UNDP(SF) type projects in Greece, India and Pakistan respectively. The project in India on nuclear research in agriculture was recently singled out by UNDP as an example of effective development aid. It is expected that work will begin on three additional Special Fund type projects during 1971 or early 1972 as shown in Table 5 below.

#### Nuclear energy and the environment

13. There is continuing public debate about the impact of nuclear energy on the environment. In some countries the great amount of authoritative information that has already been provided is helping to place the problem in the right perspective and to satisfy reasonable criticism; in others the controversy is only beginning or is still growing. The Agency is actively endeavouring to provide an objective and factual setting for the discussion of this matter, at the level of the general public as well as that of the scientific community. The Agency is thus taking part in preparations for the United Nations

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[ 4 ] Under this Article, the parties undertake to co-operate in promoting the peaceful uses of nuclear energy with due consideration for the needs of the developing areas of the world.



Conference on the Human Environment (Stockholm, June 1972), in preparing public information material and scientific publications; there remains however a wide scope for further action. In co-operation with WHO the Agency is taking steps with a view to establishing an international register of significant disposals of radioactive waste into the environment [ 5 ].

#### Nuclear power and nuclear techniques

14. The competitive position of nuclear power has improved in some countries as a result of further rises in the cost of fossil fuels and of the fact that these increases no longer seem to be temporary. The supply of nuclear power plants has become an industrial and commercial operation, and there is a tendency to standardize on large versions in the 700-1100 MW range. The Governments of several industrial countries are adjusting the responsibilities of their national atomic energy authorities to this situation. There is a trend to limit government-sponsored work to selected research and development tasks, such as the development of advanced types of reactors, particularly of breeders, and of enrichment and other fuel supply processes.

15. In the light of diminishing governmental involvement in most countries, the supply of nuclear power plants to developing countries is now normally a direct commercial transaction, often on relatively liberal financial terms. The Agency serves in several cases as an adviser on health, safety and siting questions and on legislative matters, provides some training, applies safeguards, and is able to offer advice on bid specifications and evaluations.

16. The larger sizes of the competitive nuclear power plants in advanced countries cannot be economically utilized by many developing countries until the growth of their national electric systems (grids) warrants the incorporation of large units. Nevertheless, a growing number of developing countries are reaching or approaching that stage and are ordering or considering their first nuclear plants of around 600 MW. It is estimated that nuclear power in developing countries will account for about 9-10% of the total installed nuclear capacity in 1980 (340 000 MW). The Agency is also continuing to support research and exchange of information on medium-sized plant that could be of interest to a wider range of countries. A report on the financing of nuclear power in developing countries [ 6 ] is being issued separately.

17. There has been a further integration during the year of the health and safety and nuclear medicine programmes of WHO and the Agency. Nuclear techniques are making a small but growing contribution to the "green revolution" and a considerable expansion of the work done jointly by the Agency and FAO in this field would be desirable if funds were available. During the year the two agencies and ENEA launched a self-financing international project on the wholesomeness testing of selected irradiated food products.

#### Questions of special interest to the United Nations

18. At its twenty-fifth session the General Assembly of the United Nations considered the special reports submitted by the Agency on action taken in relation to the recommendations made by the Conference of Non-Nuclear-Weapon States and on the use of nuclear explosions for peaceful purposes. The General Assembly requested that the present report should contain information, prepared in consultation with the specialized agencies and other bodies concerned, on further developments in the implementation of the results of the Conference.

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[ 5 ] See para. 103 below.

[ 6 ] GC(XV)/458.

Some of the more important developments have been referred to in preceding paragraphs. The recommendations of the Conference relate, in broad terms, to a wide range of the Agency's activities. Several sections of the present report therefore have a bearing on this matter, notably paragraphs 23 to 29 on technical co-operation, paragraphs 90 to 93 on financing nuclear energy activities, paragraphs 105 to 109 on nuclear information, paragraphs 117 to 134 on safeguards, and paragraph 21 on the composition of the Board. Comments on this matter received from IBRD, FAO and UNDP are set out in Annex B.

19. The General Assembly decided to place on its agenda for the forthcoming session the question of the establishment, within the framework of the Agency, of an international service for nuclear explosions for peaceful purposes under appropriate international control. To assist the General Assembly in its consideration of this matter attention is drawn to paragraphs 94 and 95 of the present report concerning the Agency's technical work on nuclear explosions for peaceful purposes.

20. By Resolution 2661B(XXV) the General Assembly also invited the Agency to pay attention to the safeguards required with respect to new techniques for uranium enrichment and to inform the General Assembly at its twenty-sixth session of its consideration of the subject. This matter is dealt with in paragraphs 121 and 122 of the present report.

#### Composition of the Board of Governors

21. In Resolution GC(XIV)/272 the General Conference requested the Director General to report at its fifteenth regular session on progress made towards entry into force of the amendment of Article VI of the Statute which it had approved by that resolution. By 30 June the Secretariat had been informed by the depositary Government for the amendment that five Members had accepted it, namely Denmark, Japan, Kuwait, Norway and the United Kingdom of Great Britain and Northern Ireland. [7 ]

#### Membership of the Agency

22. Nicaragua ceased to be a Member of the Agency upon notification to the depositary Government to that effect on 14 December 1970. The Agency's membership now stands at 102.

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[7] For subsequent acceptances, see the latest revision of document GC(XV)/INF/129.

## PROGRAMMES OF ACTIVITY

## TECHNICAL CO-OPERATION

General

23. In 1970, 4.6 million dollars were available for technical assistance and training compared to 3.7 million dollars in 1969. The breakdown is given in Table 1 below:

Table 1

## Technical co-operation resources

	<u>1969</u> (in thousands of dollars)	<u>1970</u> (in thousands of dollars)
Regular programme	1586	1749
UNDP(TA)	748	1134
UNDP(SF)	792	666
Assistance in kind (estimated value)	624	1042
	<u>3750</u>	<u>4591</u>

Experts and equipment

24. As shown in Table 2 below, the value of approved requests for experts and equipment under the Agency's regular programme increased from \$977 000 in 1969 to \$1 891 000 in 1971, and from 26.4% to 52.5% of the aid requested in this form. The nominal value of this programme is thus some 90% greater than it was in the years 1967 to 1969, but part of this increase has been absorbed by higher costs.

Table 2

## Experts and equipment

Year	Value of requests received (in thousands of dollars)	Value of assistance approved (in thousands of dollars)	Percentage of requests met
1966	3 000	901.6	30.0
1967	2 600	975.0	37.5
1968	3 600	977.0	27.1
1969	3 700	977.0	26.4
1970	3 400	1 250.0	36.8
1971	3 600	1 891.0	52.5

25. Other developments in the regular programme include:

- (a) The share of resources allocated to equipment rose from 18.5% in 1966 to 25% in 1970, and to 29% in 1971;
- (b) The number of Member States receiving experts or equipment, or both, rose from 40 in 1966 to 52 in 1971; and
- (c) In the 1971 programme 27 requests were found to be technically sound but could not be met because of lack of funds (as compared to 44 in 1970). As is customary, these requests were brought to the attention of technically advanced Member States.

### Training

26. Trends in fellowship awards over the period 1966-1971 are shown in the following table:

Table 3  
Distribution of fellowship awards

Type of fellowship	1966	1967	1968	1969	1970	1971 <sup>a/</sup>
Type I	82	113	121	118	159	118
Type II	137	138	148	146	164	181
UNDP(TA)	64	18	46	30	34	24
<b>TOTAL</b>	<b>283</b>	<b>269</b>	<b>315</b>	<b>294</b>	<b>357</b>	<b>323</b>

a/ Fellowships awarded by 30 June 1971 at which date most of the awards for the year will have been made. The figures given for preceding years cover in each case the complete year. It should be noted further that the figures for 1970 and 1971 do not include fellowships for study at the International Centre for Theoretical Physics at Trieste.

27. A list of the fellowships made available to the Agency free of charge by Member States in 1970 is given in Annex D. Some of these Type II fellowship openings were carried over from a previous year's offer.

28. Table 4 below provides an analysis of the 15 training courses, three study tours (seminars), three demonstration projects and the summer school that the Agency arranged in 24 countries from mid-1970 to mid-1971. One training course was jointly sponsored by FAO, another was financed out of funds provided by SIDA, and the cost of one study tour was met out of FAO's UNDP(TA) allocation for regional projects.

Table 4

## Regional and interregional short-term training projects

Project	Place and dates	Total number of participants	Source of funds
Interregional training course on nuclear techniques in the mining industry	Cracow, Poland 8 June to 4 July 1970	19	UNDP(TA)
Interregional training course on the use of isotopes and radiation in animal science	Ithaca, United States 20 July to 4 September 1970	18	Regular programme
FAO/IAEA group fellowship study tour on the use of isotopes and radiation in agricultural research	The Soviet Union 4 August to 3 September 1970	14	FAO
Study tour (seminar) on the industrial application of radioisotopes and radiation	Canada and the United States - 8 August to 19 September 1970	18	Regular programme
Interregional training course on the use of isotopes and radiation in soil plant nutrition studies	Wageningen, Netherlands 10 August to 25 September 1970	19	Regular programme
International advanced summer school on reactor physics	Herceg-Novi, Yugoslavia 31 August to 10 September 1970	90	UNDP(TA)
Interregional training course on uranium ore analysis	Madrid 7 September to 27 November 1970	22	UNDP(TA)
Regional training course on industrial radiation processing	Tokyo and Takasaki, Japan - 5 October to 13 November 1970	17	UNDP(TA)
Regional training course on radiation dosimetry	San Juan, Puerto Rico 5 October to 27 November 1970	9	UNDP(TA)
Advanced regional training course on plans and procedures for radiation emergencies	Buenos Aires 9 to 20 November 1970	24	UNDP(TA)
Interregional training course on nuclear law	Athens 7 to 18 December 1970	18	Regular programme

Project	Place and dates	Total number of participants	Source of funds
Regional training course on general isotope techniques	Cairo, Middle Eastern Regional Radioisotope Centre for the Arab Countries - 12 April to 1 May 1971	11	UNDP(TA)
International training course on radioimmunoassay techniques	Pisa, Italy 3 to 14 May 1971	40	Regular programme
Regional training course on the application of isotope techniques in hydrology	Bangkok 3 May to 11 June 1971	15	UNDP(TA)
Study tour on standardization of radiation dosimetry	Czechoslovak Socialist Republic, France, the Soviet Union and the United Kingdom 6 May to 25 June 1971	29	Regular programme
Regional training course on radioisotope laboratory techniques	Kwabinya, Ghana 10 May to 27 August 1971	20	UNDP(TA)
International training course on the use of radiation and other mutagen treatments for crop improvement	Lund and Svalöf, Sweden and Risö, Denmark 2 June to 10 July 1971	15	SIDA
International training course on the use of radioisotopes and radiation in animal science and veterinary medicine	Fort Collins, Colorado, United States 7 June to 16 July 1971	18	Regular programme
International training course on the use of radioisotopes and radiation in entomology	Gainesville, Florida, United States 21 June to 13 August 1971	20	Regular programme
Training and demonstration programme on advanced atomic energy technology	Asia and the Far East 1970/71	19	UNDP(TA)
Training and demonstration programme on advanced atomic energy technology	Europe and the Middle East 1970/71	24	UNDP(TA)
Research and demonstration project on isotopes in animal parasitology	Kabete, Kenya 1970/71	4	UNDP(TA)

29. UNDP(SF) projects which the Agency is already carrying out or has been designated to undertake are summarized in Table 5 below.

Table 5

UNDP (SF) projects for which the Agency is the executing agency

Recipient country and title of the project	Start of field operations	Project duration (years)	Government contribution (in dollars)	UNDP contribution (in dollars)
INDIA, Nuclear research in agriculture	14 October 1968	4.0	2 630 900	1 389 700
GREECE, Exploration for uranium in Central and Eastern Macedonia and Thrace <sup>a/</sup>	18 May 1971	1.5	251 300	305 800
PAKISTAN, Detailed exploration of uranium and other radioactive occurrences in the Siwalik sandstones in the Dera Ghazi Khan District, West Pakistan <sup>a/</sup>	1 July 1971	2.0	456 500	403 400
INDIA, Demonstration plant for irradiation sterilization of medical products	1 December 1971	3.0	623 500	614 000
ARGENTINA, National centre for non-destructive testing and quality control <sup>b/</sup>	1 January 1972	3.0	1 161 600	576 900
CHILE, National nuclear energy centre	1 March 1972	3.0	1 713 700	738 400

<sup>a/</sup> To be implemented in association with the United Nations.

<sup>b/</sup> To be implemented in association with UNIDO.

## FOOD AND AGRICULTURE

General

30. A large part of the work of FAO and the Agency to foster the use of nuclear science and techniques in food and agriculture continues to take the form of co-ordinated research programmes. These are summarized in Table 6 below. A special report on this work, entitled "Nuclear Techniques and the Green Revolution" was made to ECOSOC this year. [8]

Table 6

## Co-ordinated research programmes in nuclear applications in food and agriculture

Research programme	Countries in which co-ordinated research programmes are being carried out	Agency contribution in dollars 1970/71
1. Rice production	Burma, Ceylon, China, India, Indonesia, Republic of Korea, Pakistan, Philippines, Thailand, Viet-Nam	25 420
2. Wheat fertilization	Brazil, Greece, Hungary, India <sup>a/</sup> , Iran, Italy <sup>a/</sup> , Lebanon, Mexico, Morocco, Pakistan, Peru, Romania, Turkey, United Arab Republic, Uruguay	36 000
3. Tree crop fertilization	Ceylon, China, Colombia, Ghana, Ivory Coast <sup>a/</sup> , Kenya, Malaysia <sup>a/</sup> , Philippines, Spain, Uganda	26 650
4. Water use efficiency	Belgium, Federal Republic of Germany <sup>a/</sup> , Iran, Iraq, Israel, Lebanon, Pakistan, United Arab Republic	18 020
5. Physico-chemical relationship of soils and plants	Belgium, Canada <sup>a/</sup> , Ghana, Hungary, Netherlands <sup>a/</sup> , Pakistan (2), Madagascar, United Kingdom <sup>a/</sup> , United States <sup>a/</sup>	11 500
6. Rice mutation breeding	Brazil, Ceylon, India, Republic of Korea, Pakistan, Viet-Nam	21 000
7. Production and use of induced mutations in plant breeding	Argentina, Australia, Denmark <sup>a/</sup> , Federal Republic of Germany <sup>a/</sup> , India <sup>a/</sup> , Italy <sup>a/</sup> , Japan <sup>a/</sup> , Sweden (2 <sup>a/</sup> ), Soviet Union <sup>a/</sup> , United States (2 <sup>a/</sup> ), Yugoslavia <sup>a/</sup>	6 000

[8] INFCIRC/146/Add. 1.



Research programme	Countries in which co-ordinated research programmes are being carried out	Agency contribution in dollars 1970/71
8. Neutron seed irradiation	Bulgaria, China, Federal Republic of Germany <sup>a/</sup> , Italy <sup>a/</sup> , Puerto Rico <sup>a/</sup> , United States (3 <sup>a/</sup> ), Venezuela	2 500
9. Plant protein improvement	China, India, Japan, Republic of Korea, Pakistan, Philippines, Thailand	21 000
10. Trace element metabolism and disease in live-stock	Argentina, Austria <sup>a/</sup> , Cuba, Denmark <sup>a/</sup> , Federal Republic of Germany (2 <sup>a/</sup> ), Netherlands <sup>a/</sup> , United Kingdom (2 <sup>a/</sup> ), United States (3 <sup>a/</sup> ), Yugoslavia <sup>a/</sup>	7 350
11. Parasitic diseases in domestic animals	Denmark <sup>a/</sup> , Kenya (2), Israel <sup>a/</sup> , Italy <sup>a/</sup> , United Kingdom <sup>a/</sup> , United States <sup>a/</sup> , Yugoslavia <sup>a/</sup>	9 000
12. Fruit fly eradication or control by the sterile-male technique	Federal Republic of Germany <sup>a/</sup> , Mexico, Netherlands (2), Portugal, Spain, Switzerland <sup>a/</sup>	17 000
13. Control of animal insect pests by the sterile-male technique	Belgium <sup>a/</sup> , El Salvador, Federal Republic of Germany <sup>a/</sup> , Kenya, Portugal, United Kingdom <sup>a/</sup>	14 900
14. Rice insect control and eradication	China (3), Republic of Korea, Pakistan (2), Thailand (2)	31 160
15. Ecology and behaviour of the <u>Heliothis</u> complex as related to the sterile-male technique	Argentina, Colombia, El Salvador, Mexico, United States (4 <sup>a/</sup> ), Venezuela	15 020
16. Control of insect populations by the sterile-male technique	Austria <sup>a/</sup> , United States <sup>a/</sup> , Yugoslavia	3 000
17. Fate and significance of pesticide residues in food and environment	Bulgaria, Finland, Federal Republic of Germany (2 <sup>a/</sup> ), Ghana, Hungary <sup>a/</sup> , Israel (2 <sup>a/</sup> ), Japan <sup>a/</sup> , Netherlands <sup>a/</sup> , Pakistan, Uganda, United Kingdom (2 <sup>a/</sup> ), United States <sup>a/</sup> , Yugoslavia	24 000
18. Microbiological aspects of food preservation by irradiation	Japan <sup>a/</sup> , United States <sup>a/</sup>	-

Research programme	Countries in which co-ordinated research programmes are being carried out	Agency contribution in dollars 1970/71
19. Shelf-life extension of irradiated fruits	Federal Republic of Germany, Hungary, India, Iraq, Italy <sup>a/</sup> , Mexico, Philippines	21 500
20. Preservation of fishery products by irradiation	Belgium, Federal Republic of Germany, Republic of Korea, Philippines, Spain (2), Thailand	33 000
21. General food irradiation	Netherlands, Pakistan	6 000

a/ Cost-free research agreement.

#### Soil fertility, irrigation and crop production (Programmes 1-5)

31. The first programme - Rice production - was launched in late 1969 to study the effects of different systems of irrigation and water management and different methods of using nitrogen fertilizers, on the production of rice. The rice crops being tested are locally improved varieties of the various participating countries as well as a new high-yielding variety, IR-22. In the second programme - Wheat fertilization - special emphasis has been given this year to the effects of different methods of irrigation on converting fertilizer nitrogen into grain protein. The programme was started in 1968. Programme 3 - Tree crop fertilization - has been extended for a further year in order to delineate more clearly those tree roots which are most active in absorbing plant nutrients in order to determine the most efficient placement of fertilizers. The fourth programme - Water use efficiency - which was completed in November 1970, has involved the use of the neutron moisture meter and has provided valuable information about the water requirements of maize and other crops. A similar programme is in preparation. As in the past, programme 5 - Physico-chemical relationship of soils and plants - provides basic data needed for interpreting the first four programmes. In addition a programme of low-dose irradiation of the seeds of various crop plants for stimulation of plant growth in 12 countries is co-ordinated by the Agency.

32. During the reporting period a meeting on the use of nuclear techniques in soil physics and irrigation studies was arranged, a study tour was held in the Soviet Union on the use of isotopes and radiation in agricultural research and an international training course in the Netherlands on the use of isotopes and radiation in studies of soils and plant nutrition. [9] Several research co-ordination meetings were held to plan and review the programmes.

#### Plant breeding and genetics (Programmes 6-9)

33. Programme 6 - Rice mutation breeding - was continued for the sixth year in a smaller number of countries and it is now intended to carry on this programme with external funds. The results of programme 7 - Production and use of induced mutations in plant breeding - were reviewed at a meeting in Argentina, and a new programme to develop better methods of mutation breeding will be launched. Programme 8 - Neutron seed irradiation - will be completed in 1971. One of its results has been that eight nuclear centres in seven countries

[9] See Table 4 above.

have installed a standard neutron irradiation facility which enables them to develop reproduceable results by irradiation. The aim of programme 9 is to improve the quality and quantity of protein of grain cereals and legumes, particularly in developing countries. In support of this programme, the United States has donated equipment to the Seibersdorf Laboratory. The Federal Republic of Germany has entered into an agreement with the Agency for co-ordinated research to improve protein content and quality of crops by the use of nuclear techniques, and will provide \$828 700 in support of this programme.

34. Upon the recommendation of an Agency/FAO panel, held in October 1970 at Vienna, a new co-ordinated programme on the breeding of disease-resistant mutants will be launched. An international training course on the use of radiation and other mutagens to improve crops, sponsored by SIDA, was held in Sweden and Denmark in June 1971. [9]

#### Animal production and health (Programmes 10 and 11)

35. Programme 10 - Trace element metabolism and disease in livestock - has provided useful information on analytical as well as metabolic problems of trace elements in animal nutrition. Special emphasis is now being given to the study of problems of mineral deficiency in the diets of livestock in developing countries. The main results of programme 11 - Parasitic diseases in domestic animals - were described in last year's report. [10] Further promising results have been obtained in using irradiation attenuated vaccine against protozoal diseases such as East Coast Fever and trypanosomiasis (sleeping sickness). Under the current UNDP(SF) project in India, for which the Agency is the executing agency, field tests of radiation vaccines against sheep lung worm have demonstrated that the average difference in meat weight between treated and untreated animals was 2.8 kg over a six-month period.

36. During the reporting period a panel meeting was held on the use of the nuclear techniques in studies of mineral metabolism and diseases in domestic animals as well as two international training courses in the United States and in Yugoslavia on the use of radioisotopes and radiation in animal sciences and veterinary medicine [9].

#### Insect eradication and pest control (Programmes 12-16)

37. The aims of programmes 12-16 have been described in previous reports. They are all concerned with developing and releasing radiation-sterilized insects as a means of insect control and eradication. Each programme deals with a particular insect pest, i. e. programme 12 with the Mediterranean fruit fly, programme 13 with the tsetse fly, and programme 14 with the rice stem borer, etc.

38. A symposium held at Athens reviewed the use of induced sterility in insect control and eradication; it illustrated the potential effectiveness of induced sterility in control campaigns against many harmful insect pests and the need to carry out large-scale field tests to apply the results already obtained in the laboratory and small-scale field trials. A panel on the application of the sterility principle for tsetse-fly suppression, held in France, recommended strongly that field trials be conducted in an affected area of Africa.

#### Pesticide residues and pollution (Programme 17)

39. This programme on the fate and significance of pesticide residues in food and environment was launched in 1970 for the use of tracer and irradiation techniques in study of the nature, magnitude and significance of pesticide residues and other chemical contaminants such as mercury in food and environment. Nuclear techniques provide an especially effective tool in basic studies of these growing and important problems. The programme is in accordance with recommendations of the joint FAO/WHO meetings on pesticide residues and those of expert panels on the techniques convened in Vienna. The Agency and FAO also keep under observation jointly the levels of radioactivity in food and agriculture, bearing in mind the needs of UNSCEAR for data on this subject.

[10] GC(XIV)/430, para. 22.

Food preservation (Programmes 18-21)

40. National interest in the use of irradiation to preserve food is growing, and the Agency is arranging for the exchange of an increasing volume of information about wholesomeness data, national laws and regulations on the licensing of irradiated food in consumption etc. A list of irradiated food products cleared for human consumption in different countries is given in Annex C.

41. Organizations in 20 countries are now taking part in an international project for the wholesomeness testing of irradiated food which started on 1 January 1971 as a result of preliminary work done jointly by ENEA, FAO and the Agency. WHO is taking part in the project in an advisory capacity. The main work of the project will be to arrange for the wholesomeness testing of selected irradiated foodstuffs. The first priority is being given to obtaining the data needed for the unconditional clearance for human consumption of potatoes, wheat and wheat products. A five-year provisional clearance of these foodstuffs was recommended by a joint Agency/FAO/WHO committee in April 1969. The international project has at its disposal financial and material contributions amounting to about \$300 000 a year, and has been set up initially for a period of five years.

42. Under programmes 18-21, the purposes of which are self-explanatory, research support is being given to technically and economically promising uses of radiation, e.g. the disinfection of stored food and the extension of the market life of perishable foodstuffs, such as fish, fruit and vegetables. In December 1970 a panel considered the use of radiation in solving certain important quarantine problems that hamper international trade in fruit.

## LIFE SCIENCES

Radiation biology

43. The current research support programme on radiation biology is summarized in Table 7 below.

Table 7  
Research contracts on radiation biology

Research programme	Countries in which research is conducted with Agency support	Agency contribution in dollars 1970/71
Studies on the mechanisms of radiosensitivity and repair processes (including haematopoietic, immunologic systems and pathophysiology)	Bulgaria, Chile, Czechoslovak Socialist Republic (2), Ecuador, France <sup>a/</sup> , Federal Republic of Germany, Greece, Hungary <sup>a/</sup> , Netherlands <sup>a/</sup> , Pakistan, Poland, Romania, Switzerland, Turkey (2), Uruguay	36 500
Radiation microbiology and genetics	Austria (2 <sup>a/</sup> ), Czechoslovak Socialist Republic, France (2 <sup>a/</sup> ), Greece, India, Israel <sup>a/</sup> , Republic of Korea, Nigeria, Pakistan	22 000
Modification of radiosensitivity	Algeria, Iran, Romania, Sweden, Turkey	13 000
Radiosterilization of pharmaceuticals and biomedical products	Austria, Czechoslovak Socialist Republic <sup>a/</sup> , Denmark (2 <sup>a/</sup> ), Hungary <sup>a/</sup> , Romania, Thailand, United Kingdom <sup>a/</sup> , Yugoslavia	5 500
Radiation attenuation of parasite organisms and animal toxins for production of vaccines	Belgium, Chile, China, Ethiopia, Malaysia <sup>a/</sup>	15 000
Improvement of biosphere resources by nuclear techniques	Austria <sup>a/</sup> , India <sup>a/</sup> , Nigeria, United Kingdom <sup>a/</sup>	3 000

<sup>a/</sup> Cost-free research agreement.

44. In March 1971 the Agency held a symposium in Vienna on the use of radiation and radioisotopes for genetic improvement of industrial micro-organisms. Examples of the useful products from industrial micro-organisms having nutritional and medical value include antibiotics, vitamins and many other organic compounds.

Medical applications

45. The general direction of the Agency's work on radioisotope applications in medicine remains the same as last year; research support programmes on these applications are summarized in Table 8 below.

Table 8

## Research contracts on radioisotope applications in medicine

Research programme	Countries in which research is conducted with Agency support	Agency contribution in dollars 1970/71
Anaemia	Cuba, South Africa	6 200
Whole-body counting techniques and their applications, especially in relation to problems of nutrition and public health	Brazil, Romania	5 000
Radioisotope techniques and their applications in studies of iron metabolism	Chile, India, Lebanon, Mexico, South Africa, Sudan, Thailand, Turkey, United States <sup>a/</sup>	43 350
Radioactivation techniques and their applications in studies of trace elements and mineral metabolism in man	Greece, Italy	7 800
In vitro assay techniques, such as saturation analysis and radioimmunoassay techniques and their applications	Argentina (2), Bulgaria, Chile (2), Ecuador, Greece, Republic of Korea, Nigeria (3), Peru, Uganda	60 950
Radioisotope techniques and their applications in immunological studies of communicable diseases	India, Iran, Nigeria, United States	11 925
Radiopharmaceuticals and techniques for scintigraphy and their applications	Brazil, Greece, India, Poland, Uruguay, Viet-Nam	19 700
Radioisotope techniques in cardiovascular studies	Argentina (2), Hungary, Spain, Sudan	22 300

<sup>a/</sup> Technical contract.

46. The first programme mentioned in Table 8 above will be completed in 1971. All other programmes for support of medical research were started in 1969 and are being continued.

47. Other activities undertaken during the reporting period include:
- (a) A symposium on the use of radioisotopes in dynamic studies in clinical medicine and research (Rotterdam, August/September 1970). It was the first meeting on this subject held by the Agency and it reviewed the use of radioisotopes in diagnosis based on observations of the uptake, metabolism, clearance or excretion of administered radioactive materials;
  - (b) A panel on the planning and organization of medical radioisotope laboratories (San Salvador, November 1970) which assisted the Agency in preparing a manual on this subject;
  - (c) A regional training course on radiation dosimetry for radiation therapy (Puerto Rico, November 1970); [ 9 ]
  - (d) An international training course on radioimmunoassay techniques (Pisa, May 1971); [ 9 ]
  - (e) A panel on measurements of radioiodine uptake by the thyroid gland (Vienna, May 1971) which made recommendations on the techniques to be used in such measurements; and
  - (f) A study tour on standardization of radiation dosimetry (May/June 1971) [ 9 ].

#### Dosimetry

48. Under the postal intercomparison service programme [ 11 ] almost 300 dosimeters have been posted to institutions in more than 45 developing countries, which represents an increase of about 60% from the previous year. Since this is now a joint Agency/WHO project, WHO has arranged payments to the Agency for each dosimeter shipment. The programme has been helped by gifts from the United States, such as the 3000-Ci teletherapy cobalt-60 radiation source and various dosimetry equipment.

49. A symposium on biophysical aspects of radiation quality, held in March 1971 at Lucas Heights, Australia, studied the effects of different types of ionizing radiations on living organisms. The papers presented covered the whole chain of events beginning at the physical problems of microdosimetry, passing through the action of radiation energy at the molecular and cellular levels up to the reactions of a biological system and the modification of its radiosensitivity.

50. Support is being given to a total of seven research contracts and agreements concerned with dosimetry as summarized in the following table.

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[ 11 ] Ibid., para. 35.

Table 9

## Research contracts on dosimetry

Research programme	Countries in which research is conducted with Agency support	Agency contribution in dollars 1970/71
Co-ordinated research programme on the biophysical aspects of radiation quality	Netherlands <sup>a/</sup> , United Kingdom (3 <sup>a/</sup> )	-
Application of polaroid film in radiation dosimetry and survey	United States <sup>b/</sup>	2 000
Deoxycytidine levels in urine and plasma as an index of ionizing radiation dose	United Kingdom	3 100
Direct internal radiation dosimetry of radiopharmaceuticals by improved needle-type fluoroglass dosimeters	Japan	4 000
Dosimetry of ionizing radiation by chemical methods	Belgium	1 500
Study of lithium fluoride thermoluminescent dosimetry system for use in postal dose intercomparison	Federal Republic of Germany	3 500

<sup>a/</sup> Cost-free research agreement.

<sup>b/</sup> Cost-free research agreement as of 1971.



## PHYSICAL SCIENCES

Physics

51. The Agency's programme on physics continues to concentrate on nuclear fission, fusion and neutron interactions and on scientific problems on which research can be done in the developing countries. The present distribution of research contracts is shown in the following table.

Table 10

## Research contracts on physics

Research programme	Countries in which research is conducted with Agency support	Agency contribution in dollars 1970/71
Neutron and nuclear physics	Brazil, Hungary, Yugoslavia	8560
Fission physics	Italy, Romania	5400
Solid-state physics and radiation damage	South Africa, Soviet Union (2), United Kingdom	8200

52. The following are some of the main meetings held on this subject during the reporting period:

- (a) A panel on pulsed neutron research (Vienna, August 1970) which reviewed progress in the use of both strong and weak pulsed neutron sources and which gave guidance on further research and future applications of such sources;
- (b) A meeting of the Joint Agency/ENEA International Thermionics Liaison Group (Washington, D.C., October 1970) which made recommendations for co-ordinating national programmes of thermionic research and plans for the Third International Conference on this subject (Jülich, Federal Republic of Germany, in 1972);
- (c) A study group on the use of low energy accelerators (Rio de Janeiro, March 1971) at which the scientists responsible for the main accelerator programmes in Latin America reviewed their past and future programmes as well as possibilities for regional co-operation;
- (d) A panel on the application of the Mössbauer Effect (Vienna, May 1971) which discussed the application of Mössbauer spectroscopy in fields ranging from nuclear and solid state physics to industrial technology; and
- (e) The fourth international conference on plasma physics and controlled nuclear fusion research (Madison, Wisconsin, United States, June 1971). Since the third conference at Novosibirsk, Soviet Union, in August 1968, there has been much experimental and theoretical progress, and for the first time at such a conference, it was possible to arrange an extensive discussion of the prospects for nuclear fusion reactors. More than 550 scientists attended the conference.

53. Promising advances in nuclear fusion and the possibility that the technical problems involved may be resolved somewhat sooner than expected has led the Agency to establish an International Fusion Research Council. This consists of scientists from all countries in which significant fusion and plasma physics research is being undertaken, as well as representatives of the regional organizations dealing with this subject. At the first meeting of the Council, held at Madison, Wisconsin, just before the conference mentioned above, recommendations were made for co-ordinating national programmes.

#### Nuclear data

54. The exchange of experimental neutron data between the four main international neutron data centres in the new computerized system EXFOR, which was described in last year's report[ 12 ], is steadily increasing. More attention is being given to the review and the exchange of data relevant to:

- (a) Fast breeder reactors;
- (b) Safeguards techniques;
- (c) Thermonuclear fusion reactors; and
- (d) Helping developing countries to take a more active part in nuclear data measurements.

55. A mission was sent to six Member States in Eastern Europe during October/November 1970 to promote a more effective exchange of nuclear data with the Agency's Nuclear Data Section.

56. In 1971 the Agency took over from ENEA the responsibility for publishing the Computer Index of Neutron Data, the bibliographic index to the literature on neutron physics data.

#### Chemistry

57. Individual projects within the Agency's programme on chemistry, during the reporting period have included:

- (a) A panel (Vienna, July 1970) on the analytical chemistry of nuclear fuels;
- (b) A meeting to review the applications of activation analysis in Member States in South East Asia and the Far East and a meeting to consider regional co-operation in research and training (both at Bangkok, July 1970). As a result of the second meeting co-operative research in neutron scattering is being continued and the possibility of establishing other regional co-operative research and training projects is being investigated; and
- (c) A regional training course on radioisotope techniques for interested developing countries in Africa (Cairo, April/May 1971). This was held in co-operation with the Middle Eastern Radioisotope Centre for the Arab Countries[ 9 ].

58. The Agency has also begun a co-ordinated research programme with institutes in Argentina, the Czechoslovak Socialist Republic, France, India, Romania and the United States on the quality control of radiopharmaceuticals; it has supported nuclear chemistry research in Italy on a study of the applications of Chotosan and naturally occurring ion-exchanger, in Indonesia on the properties and utilization of tritium, and in Sweden on electron spectroscopy for chemical analysis.

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[ 12 ] Ibid., para. 40.

Isotope hydrology

59. The Working Group on Nuclear Techniques in Hydrology of the International Hydrological Decade, for which the Agency serves as technical secretariat, held its fifth session from 28 September to 2 October 1970. A technical report on nuclear logging in hydrology (using nuclear instruments in boreholes to learn about the characteristics of underground water reservoirs) produced by the Working Group, has been published. The Agency also held a panel at Saclay, France, in June 1971 on the application of tracers in sedimentology and a regional training course at Bangkok, in May/June 1971 on the application of nuclear techniques in hydrology. The Agency has also provided lecturers to a number of training courses in hydrology organized by other international bodies.

60. The Agency has continued to collect and publish environmental isotope data from a world-wide network of precipitation stations. This world-wide monitoring of the stable and radioactive isotope content of precipitation, which is done jointly with WMO, was started in 1961. It contains data of topical interest for proposals regarding monitoring of the environment.

61. The Agency has also continued to provide services in isotope hydrology to other organizations that are carrying out major water resources development projects for UNDP in Afghanistan, Argentina, Chad, Greece (Crete), Jamaica, Morocco, Nicaragua, Senegal and Tunisia. Technical assistance in isotope hydrology was given to projects in Brazil, Chile, Colombia, Greece, Guatemala, India, Iran, Poland, Thailand, Turkey, Uruguay and Yugoslavia.

Industry

62. The support that the Agency is giving to research on industrial applications of nuclear science is shown in Table 11 below.

Table 11

Research contracts on industrial applications  
of radioisotopes and radiations

Research programme	Countries in which research is conducted with Agency support	Agency contribution in dollars 1970/71
Mineral exploration and exploitation	Czechoslovak Socialist Republic, Indonesia, Philippines, Romania	11 700
Impregnated fibrous materials	Finland, Iraq, Romania	11 000
Nuclear moisture and density gauging	United States <sup>a/</sup>	-
Liquid flow studies	Poland <sup>a/</sup>	-
Isotopic ratios in oil field evaluation	Romania	3 500
Tracer techniques in water pollution	Yugoslavia	4 500

<sup>a/</sup> Cost-free research agreement.

63. The interest of developing countries in radioisotope and radiation applications in industry is growing steadily, as is shown by proposals now being made to UNDP for large, Special Fund type projects.
64. Other projects undertaken during the reporting period have included:
- (a) A panel at Seoul, Republic of Korea, in September/October 1970, which evaluated the use of radiation processing techniques from the standpoint of industry in developing countries;
  - (b) A symposium on the use of nuclear techniques for the measurement and control of environmental pollution (Salzburg, Austria, October 1970) which was the first international meeting to deal comprehensively with the use of these techniques in studying the effects of pollution from non-nuclear activities such as the chemical industry, *sewage disposal and fossil fuel power stations*. The main use of the techniques is in the precise measurement and analysis of such pollutants; and
  - (c) A study tour on industrial applications of radioisotopes and radiation technology in Canada and the United States in August/September 1970; [ 9 ] a regional training course on industrial radiation processing, in Japan in October/November 1970; a tour of experts on the use of radiation and isotopes for industrial measurements and for the exploitation of mineral resources which visited five Member States in Asia and the Far East in November/December 1970.

#### Laboratories

65. Since the special annual report on the activities of the Agency's laboratories will no longer be published, their work is briefly described in the following paragraphs.

##### Seibersdorf Laboratory

66. Most of the work of the Seibersdorf Laboratory consists of supporting various programmes in the application of radiation and isotopes and in safeguards. Thus, in agriculture, support - mainly analytical - is given to the crop fertility, mutation breeding and insect control programmes. The Laboratory has supplied isotopically labelled fertilizers and carried out isotope analyses of plant samples for the co-ordinated research programmes referred to in paragraphs 32-42 above. Development has been continued on improved techniques for isotope analyses. A field experiment supporting the co-ordinated wheat fertilizer programme has been carried out to study the efficiency of conversion of fertilizer nitrogen to grain protein under varied soil moisture conditions. Mutation plant breeding research has been increasingly directed to improving protein quality and raising protein content in cereals. Genetical work is supplemented by research on methods for analysis of protein and amino acid. In support of the programmes of insect control by the sterile insect release technique experiments are being carried out on mass rearing of Mediterranean fruit flies, olive flies, tsetse flies and the almond moth. Studies are being made of sterilization doses and of methods to increase competitiveness (ability of sterile males to compete with normal males for females). In co-operation with institutes in Spain and Tunisia, pilot-scale releases of the Mediterranean fruit fly have been carried out in the field.

67. Support for safeguards work has included analysis of samples - mainly uranium and plutonium - brought back by inspectors and maintenance and calibration of safeguards instruments. In addition, quality control samples have been prepared for the analytical services of inspected installations. The programme of analytical quality control has been extended to include samples of safeguards interest.

68. At the request of WHO independent studies and comparisons have been made of analytical methods for the control of the quality of radiopharmaceuticals. Studies of analytical methods have also been undertaken to assist the co-ordinated research programme on mineral exploration and exploitation. The programme for the distribution of calibrated radioactive sources has been reduced because of the availability of similar sources from some national laboratories and commercial suppliers. Some special calibration sources, however, are still included in the distribution of neutron activation monitors.

69. The Laboratory has also provided training in physics, chemistry and agriculture to fellowship holders from China, Cyprus, the Czechoslovak Socialist Republic, Hungary, India, Lebanon, Pakistan, Romania and the United Arab Republic.

#### International Laboratory of Marine Radioactivity in Monaco

70. The Agency's programme of health, safety and waste management, to which the Monaco Laboratory lends its support, is described in paragraphs 96-104 below. The main emphasis in the work at Monaco is on standardizing and calibrating the analytical methods used by national laboratories in studies concerning effects of radioactivity on the sea and on life therein. To help this standardization, contaminated sea water samples were distributed to 53 laboratories in 26 countries and the results were reported back in early 1971 and are now being compared. UNESCO is making a financial contribution of \$2000 per year to this programme.

## NUCLEAR TECHNOLOGY

General

71. Nine new power reactors, having an aggregate capacity of 4652 MW became critical in 1970, thus increasing total nuclear capacity to 20 088 MW at the end of the year. During the first half of 1971 a further four power reactors, with an aggregate capacity of 2213 MW became critical. In 1970 approximately 25 000 MW of nuclear capacity was ordered, considerably more than the 19 000 MW ordered in 1969, but still below the 1967 peak of 30 000 MW. Because of significant increases in world oil prices and the rising cost of coal in the United States the outlook for new orders in 1971 is favourable.

72. Forecasts for 1975, 1980 and 1985 are given in Table 12. The 10% uncertainty factor shown for 1975 reflects principally the possibility of delays in commissioning. The 20% and 30% uncertainty factors shown for 1980 and 1985 respectively reflect uncertainties concerning future trends in the capital and fuel costs of fossil and nuclear plants.

73. In 1970 nuclear capacity in the developing countries amounted to 533 MW, less than 3% of the world total. The corresponding forecasts for 1975, 1980 and 1985 are 5%, 10% and 12% respectively of the total, but in 1980 and 1985 they are subject to even greater uncertainty than the projected world totals for those years because of the problem of securing the foreign exchange that developing countries would need for nuclear plants.

Table 12

Estimates of total and nuclear electrical generating capacity  
1975-1985<sup>a/</sup> (1000 MW)

	1975			1980			1985		
	Total	Nuclear	Nuclear share (%)	Total	Nuclear	Nuclear share (%)	Total	Nuclear	Nuclear share (%)
Industrial countries	1330	109	8.2	1890	305	16	2670	625	23
Developing countries <sup>b/</sup>	250	6	2.4	380	35	9	550	85	16
World <sup>c/</sup>	1580	115	7.3	2270	340	15	3220	710	22
(Uncertainty in nuclear estimate)		(± 10%)			(± 20%)			(± 30%)	

a/ At the end of the year.

b/ Countries for which a UNDP technical assistance programme was approved for 1970.

c/ Excluding China (mainland).

Reactor technology

74. An early development of fast-breeder reactors remains the main objective of the reactor development programmes of leading industrialized countries. The progress achieved in these programmes was reviewed at the annual meeting of the Agency's international working group on fast reactors in May 1971 which also discussed plans for future

international meetings on this subject. Four specialized meetings during the reporting period discussed respectively cladding failure detection and localization in fast reactors (Cadarache, France, October 1970); fast-reactor spectrum measurements and their interpretation (Argonne, United States, November 1970); operational safety of sodium circuits (Risley, United Kingdom, March 1971); and sodium water reactions (Melekes, Soviet Union, May 1971).

75. Commercial power reactors are already producing more than three tons of plutonium a year and are likely to produce 30 tons a year by 1975. In the long run, the main use of plutonium will be as a fuel for fast reactors but, for economic reasons, there is much interest in putting this expensive material to use as soon as possible by re-cycling it in existing (thermal) nuclear reactors. The technical problems involved in this re-cycling were reviewed by an Agency panel in June 1971.

76. By mid-1971, more than 100 nuclear power reactors were in operation in 14 countries, yielding valuable data on performance, safety and reliability. In September 1970, the Agency issued the first in a series of annual reports on operating experience in nuclear power stations covering 67 plants. The report showed that, while earlier stations had had many teething problems, the initial data from the new generation of nuclear plants has shown that they are performing better and showing higher availability.

77. In October 1970 a joint Agency/ECE symposium considered the special problems of integrating nuclear power plants into existing grids. The requirements for the economic operation of a nuclear plant differ from those of conventional plants and the operation of a number of interconnected stations of different sizes and types presents complex problems. These matters and the role that international and regional co-operation could play in solving them were considered.

78. There is renewed interest in the use of nuclear power in merchant ship propulsion and the Agency, in co-operation with IMCO and the Federal Republic of Germany, held a symposium on nuclear ships at Hamburg in May 1971, which attracted more than 400 participants. More than 50 papers presented reviewed the special problems of safe design and of operation of nuclear ships as well as their economic potential. The most optimistic views expressed were that nuclear ships can become an important new civil use of nuclear technology in the next decade.

79. The Agency's international working group on the engineering aspects of irradiated embrittlement of reactor pressure vessels met at Vienna in May 1971. It is likely that sub-groups will be established on steel and concrete pressure vessels respectively. A special meeting was held on irradiated embrittlement of pressure vessel steels.

#### Nuclear desalting

80. Nuclear desalting continues to attract interest as a means of solving the problem of water supply to cities in arid areas. The Agency has helped the Pakistan Atomic Energy Commission to review the prospects of using this technique in Karachi and is giving similar assistance to the Government of Kuwait.

81. While no nuclear agro-industrial complexes are as yet in sight, the long-term interest of this concept is considerable since it could offer an important means of economic development in particular areas. In March 1971 an Agency study group reviewed recent developments in nuclear desalting and the use of desalted water in agriculture and industry. A monograph is being prepared on nuclear agro-industrial complexes, as a guide to countries interested in studying their long-term feasibility. In April 1971 a panel on the storage and transport of water from nuclear desalting plants provided advice on the technical aspects of these subjects; the integration of desalting plants into existing water supply systems is an important matter which has to be considered in studying the municipal or the agro-industrial use of desalted water.

Nuclear materials

82. As Table 13 below (based on an Agency/ENEA survey of April 1970) shows, there has been a considerable growth in proven uranium resources since the previous Agency/ENEA survey in 1967.

Table 13

Short tons  $U_3O_8$  reserves at a price below ten dollars

Country	1967	1970
Canada	200 000	232 000
France	45 000	45 000
South Africa	205 000	200 000
United States	180 000	250 000
Others	70 000	113 000
Totals	700 000	840 000

The increased reserves are largely the result of the intense exploration and development carried out during the three previous years in Australia, Canada, the Central African Republic, Gabon, Niger and the United States in anticipation of the expected increase in world demand. Since the April 1970 survey, further important discoveries have been reported in Australia.

83. It will, nevertheless, be necessary to build more uranium production capacity and to continue the present high level of exploration during the 1970s to satisfy the nuclear power demands of the future. To help Member States in this regard the Agency held a panel on uranium exploration geology, in Vienna in April 1970, and conducted a training course in Madrid from September to November 1970 on uranium ore analysis. The Agency, as executing agency and in association with the United Nations, is carrying out UNDP(SF) projects for uranium exploration in Greece and Pakistan.

Supply of nuclear materials

84. There has been a considerable increase since 1969 in the number of requests for nuclear materials being made to and met by the Agency. The requests approved or implemented during the reporting period are shown in Table 14 below. As in the past, nearly all the requests have been for small quantities of nuclear material for research purposes.



Table 14

## Supply of nuclear materials

Receiving State/ Organization	Purpose	Quantity and type of fissile material	Approximate enrichment (when applicable)
Algeria	Standard reference material in mineral form	0.3-0.5% uranium <sup>a/</sup>	
Argentina	Nuclear fuel tests	200 kg oxide uranium	1.162%
Brazil	Production of radioisotopes and separation of fission products with a long half-life	465 g <sup>235</sup> U <sup>a/</sup>	93%
Burma	Neutron source	16 g Pu <sup>a/</sup>	
Burma	Irradiation targets	5 mCi <sup>238</sup> Pu, 1 mg <sup>239</sup> Pu, 5 mg <sup>233</sup> U, 50 mg <sup>235</sup> U <sup>a/</sup>	
Ceylon	Neutron source	80 g Pu <sup>a/</sup>	
China	Research	<sup>235</sup> U, <sup>239</sup> Pu, <sup>237</sup> Np contained in 5 samples <sup>a/</sup>	
Congo, Democratic Republic of the	Fission counter	1.20 g <sup>235</sup> U <sup>a/</sup>	93%
Congo, Democratic Republic of the	Fuel for a research reactor	3 kg <sup>235</sup> U	20%
Finland	Fission counter	1.68 g <sup>235</sup> U <sup>a/</sup>	
Greece	Fuel for a research reactor	6340 g <sup>235</sup> U	90%
Hungary	Research	Pu foil <sup>a/</sup>	
IAEA	Research	<sup>235</sup> U contained in 8 samples <sup>a/</sup>	
India	Standard reference material	3 g uranium oxide, 0.25 g plutonium sulphate <sup>a/</sup>	
India	Standard reference material	0.5 g plutonium metal <sup>a/</sup>	
India	Research	100 mg <sup>242</sup> Pu	

Receiving State/ Organization	Purpose	Quantity and type of fissile material	Approximate enrichment (when applicable)
India	Research	100 mg PuO <sub>2</sub> containing <sup>242</sup> Pu <sup>a/</sup>	
Indonesia	Neutron source	80 g Pu <sup>a/</sup>	
Iraq	Neutron source	16 g Pu <sup>a/</sup>	
Mexico	Fuel for a training reactor	3750 g <sup>235</sup> U	20%
Pakistan	Irradiation targets	5 g <sup>239</sup> Pu, 300 mg <sup>240</sup> Pu, 9 g <sup>235</sup> U, <sup>252</sup> Cf <sup>a/</sup>	
Pakistan	Fuel for a power reactor	1.7 kg <sup>235</sup> U	10.49%
Pakistan	Replacement booster rods for power reactor	10 kg <sup>235</sup> U	10.5%
Poland	Research	<sup>235</sup> U, <sup>237</sup> Np contained in 5 fission foils <sup>a/</sup>	
Romania	Research	<sup>235</sup> U, <sup>239</sup> Pu contained in 2 fission foils <sup>a/</sup>	
Singapore	For use in a radioisotopes in industry technical assis- tance programme as neutron source	16 g Pu <sup>a/</sup>	
United Arab Republic	Neutron source	80 g Pu <sup>a/</sup>	
United Arab Republic	Research	500 μg Pu <sup>a/</sup>	
United Arab Republic	Neutron source	16 g Pu <sup>a/</sup>	
Yugoslavia	Fuel for a research reactor	4750 g <sup>235</sup> U	20%
Yugoslavia	For testing of fuel element	440 g <sup>235</sup> U <sup>a/</sup>	
Yugoslavia	Research	600 mg <sup>235</sup> U <sup>a/</sup>	

<sup>a/</sup> Request met by the Director General under the authority delegated to him by the Board in September 1968.

85. The allocation of special fissionable material to the value of \$50 000 granted by the United States for 1970 is shown in the table below.

Table 15  
Allocation of special fissionable material granted by the  
United States for 1970

Receiving State	Value in dollars
Brazil	5 192
Chile	24 022
Greece	1 038
Indonesia	14 162
Yugoslavia	5 586
	50 000

#### Reactor physics and research reactors

86. By mid-1971 there were 45 research reactors in 27 developing countries. The Agency has continued to help the countries concerned to make full use of these reactors by providing research support, expert services, technical assistance and forums for discussion of common problems.

87. In July 1970 a panel meeting at Vienna discussed the role of small reactor centres in nuclear engineering research, the help that the Agency could give in this connection and the work that could be undertaken at such centres.

88. The seven-year-old NPY Agreement which expired in April 1971 has shown the value of collaboration between relatively small centres. The countries concerned have decided to continue their collaboration by co-ordinated research programmes and one such programme is now being started by the Agency. Reports on the results of research done under the NPY Agreement and the earlier Agency/Norway (NORA Project) Agreement were published by the Agency. Lectures on recent advances in reactor physics were delivered at the Third International Advanced Summer School in Reactor Physics at Herceg Novi, Yugoslavia in August/September 1970.

89. The following were the main activities during the reporting period to promote progress in reactor physics and related subjects:

- (a) A joint Agency/ENEA specialist meeting on the physical problems of reactor shielding was held at Paris in December 1970 to review recent advances in reactor shielding science;
- (b) A working group on nuclear power plant control and instrumentation has been set up. Scientists from 22 Member States and four international organizations are taking part. The working group deals with all main aspects of reactor control and safety and at its first meeting in March 1971 it identified problems which currently require special attention;
- (c) The working group on reactor radiation measurements has been reorganized and at a meeting in April 1971 plans were drawn up for intercomparison experiments; and

- (d) Meetings of the Agency/ENEA liaison group on MHD electrical power generation were held in November 1970 and April 1971 and the Fifth International Conference on this subject, sponsored by the two agencies, at Munich in April 1971, discussed more than 100 reports on recent research. While a great part of the potential interest in MHD relates to the direct use of fossil fuels in generating electrical power, it continues to present a potential means of direct conversion from high temperature reactors and to have relevance to the development of plasma physics.

#### Financing of nuclear power in developing countries

90. The problems of financing nuclear power in developing countries, which were amongst the matters discussed extensively at the Conference of Non-Nuclear-Weapon States as well as at the Agency's General Conference in 1969 and 1970, have continued to receive special attention. Estimates made on the basis of information available to the Agency, indicate a potential market in the developing countries of between 40 000 and 60 000 MW of nuclear generating capacity during the next ten years. This nuclear generating capacity would represent about one-fifth of the estimated total electrical generating capacity in these countries.

91. The financing required for this overall increase in electrical generating capacity would be about \$40 000 million if it was all conventional oil fired plant, and about \$45 000 million if 20% of it was nuclear plant. However the installation of this amount of nuclear plant, which could be run as base load plant, could bring the developing countries considerable savings in foreign exchange, over the life of the plant, provided the capital costs are reasonable and that nuclear fuel costs remain lower and more stable than oil fuel costs.

92. The chief problem is that a nuclear power plant has a higher capital cost - and foreign exchange component - than a coal, oil or other fossil fuel plant of the same size. For technical reasons this gap widens as the size of the plant decreases. For plants of the capacity that is of interest to most developing countries, the problem is aggravated by the fact that there are currently very few orders - and hence little interest on the part of manufacturers - for nuclear power stations smaller than 500 MW. In fact the average size of plant now being ordered in manufacturing countries has steadily increased and is now almost 900 MW. Only one of the 28 nuclear power plants ordered in 1970 in manufacturing countries was smaller than 500 MW, but it must be remembered that several reactors of less than 500 MW have been operating successfully for a number of years.

93. The technical and economic characteristics of nuclear reactors that could be used in the smaller electrical grids of developing countries were reviewed at an Agency symposium in Oslo in October 1970. The discussion showed that there may be considerable potential demand for power reactors smaller than 500 MW in certain regions of the industrial as well as in the developing countries. Standardization of size and simplification of design were suggested as means of reducing capital cost. To stimulate the interest of the nuclear industry, it is desirable that reliable information should be collected on the future requirements for such plants. The Agency is continuing to seek this information and, through a co-ordinated programme of research agreements with industrial organizations in Belgium, the Federal Republic of Germany and the Soviet Union, to obtain better technical and cost data about such plants.

#### Nuclear explosions for peaceful purposes

94. Article V of NPT provides for international co-operation in sharing with non-nuclear-weapon States party to the Treaty the potential benefits that may be derived from the use of nuclear explosions for peaceful purposes. After the first international technical meeting on

this subject in March 1970 [ 13], a group of experts met at the Agency's Headquarters in November 1970 to consider the particular question of the appropriate international observation of peaceful nuclear explosions. Such international observation is foreseen by NPT and the meeting also gave effect to a suggestion made by the General Assembly of the United Nations in Resolution 2605 B (XXIV). After preliminary consideration of the group's report by the Board in February 1971, all Member States wishing to do so were invited to comment on the report. A few Member States have already submitted comments, and the Board expects to give further consideration to the subject at a future meeting in the light of all comments received by then.

95. Technological and economic considerations indicate that the first industrial uses of peaceful nuclear explosions are likely to be of the contained type, i. e. where the explosions do not vent to the surface. Potential applications include the development of mineral resources, the improved recovery of oil and gas from relatively impermeable formations and the creation of storage facilities for hydrocarbons among others. Accordingly in January 1971 the second international technical meeting on this subject was concentrated on contained (underground) peaceful nuclear explosions. The discussion showed that it is technologically possible at present to use underground nuclear explosions on an industrial scale to stimulate gas and oil production, to prepare storage space for hydrocarbons (gas, oil and oil products) in the cavities or chimneys produced by such explosions and to seal gas and oil wells that are out of control. More practical experience in the technology and availability of more data on the effect of multiple explosions will however be necessary, before the application of this technique can be economic.

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[ 13] Ibid., para. 69.

## HEALTH, SAFETY AND WASTE MANAGEMENT

General

96. In the period covered by this report, particular attention has been given to:
- (a) Questions relating to radioactive contamination of the environment;
  - (b) Revising the Agency's safety standards and recommendations;
  - (c) Helping Member States to apply these standards and recommendations; and
  - (d) Providing radiological protection services for the Agency's laboratories and in connection with safeguards inspections.

97. Thirteen publications were issued, among them four technical reports, the proceedings of five symposia and panels, three safety reports and one bibliographical review. Four panels were held on various subjects as well as three symposia, one seminar and eight meetings of experts.

98. The Agency has continued to collaborate closely with WHO in planning and carrying out programmes related to health, safety and waste management as is shown, for instance, by the number of jointly-issued publications and joint activities. There has also been close collaboration with ILO, FAO and ENEA in regard to those parts of the programmes that are of interest to these organizations.

Research support

99. Table 16 below shows the distribution of research contracts and agreements relating to radiation protection, waste management and environmental pollution.

Table 16

Research contracts and agreements on radiation protection  
and waste management

Research programme	Countries in which research is conducted with Agency support	Agency contribution in dollars 1970/71
General matters of radiation protection	Austria, Brazil, Bulgaria, Czechoslovak Socialist Republic, Greece, Israel, Pakistan, Poland, United Kingdom, Yugoslavia	28 100
Co-ordinated research in accident dosimetry	Canada <sup>a/</sup> , Czechoslovak Socialist Republic <sup>a/</sup> , France <sup>a/</sup> , Federal Republic of Germany <sup>a/</sup> , Hungary <sup>a/</sup> , India <sup>a/</sup> , Poland, United Kingdom <sup>a/</sup> , Soviet Union <sup>a/</sup> , United States <sup>a/</sup> , Yugoslavia <sup>a/</sup>	5 000
Co-ordinated research on estimation of plutonium by external counting	United Arab Republic, Soviet Union <sup>a/</sup>	7 000

Research programme	Countries in which research is conducted with Agency support	Agency contribution in dollars 1970/71
Measurement techniques	Belgium, Bulgaria, Czechoslovak Socialist Republic <sup>a/</sup> , France, India, Republic of Korea, Romania	27 740
Transport packagings	Sweden <sup>a/</sup>	-
Low- and medium-level radioactive waste management	Bulgaria, China, Federal Republic of Germany <sup>a/</sup> , Hungary, India, Republic of Korea, Pakistan, Philippines, Romania, Soviet Union	39 100
Research in marine radioactivity	Argentina <sup>a/</sup> , Belgium, Finland <sup>a/</sup> , India <sup>a/</sup> , Israel, Italy (2 <sup>a/</sup> ), Japan <sup>a/</sup> , Netherlands <sup>a/</sup> , New Zealand, Norway, Romania (2 <sup>a/</sup> ), Spain, Turkey, United Kingdom <sup>b/</sup> , United States <sup>b/</sup> , Yugoslavia <sup>a/</sup>	44 180

<sup>a/</sup> Cost-free research agreement.

<sup>b/</sup> Technical contract.

#### Radiological safety

100. The following are some of the main activities concerned with radiological safety undertaken during the period covered by this report:

- (a) A symposium on new developments in physical and biological radiation detectors (Vienna, November 1970) which paid special attention to the standardization of instruments and of measuring techniques to assess radiation doses during normal operations and in the event of an accident;
- (b) A panel on inhalation risks from radioactive contaminants (Vienna, November/December 1970);
- (c) A seminar on test requirements for packaging for the transport of radioactive materials (Vienna, February 1971) which critically reviewed the test requirements of the transport regulations, in particular the impact and thermal tests;
- (d) Meetings of groups of consultants have carried out the following tasks:
  - (i) Drawing up a guide on the safe use of radioactive tracers in industry (Vienna, July 1970);
  - (ii) Preparing a manual on radiation protection in using unsealed radioactive sources in hospitals (Vienna, October 1970);

- (iii) Revising the Health Physics Addendum to the Agency's Code of Practice on the Safe Handling of Radioisotopes (Vienna, February 1971); and
- (iv) Preparing a manual on neutron monitoring (Vienna, June 1971);
- (e) An advanced regional course on plans and procedures for radiation emergencies (Buenos Aires, November 1970) for specialists in countries in Latin America; and
- (f) A visit by a group of experts (visiting seminar) on monitoring and other problems in radiation protection to Ceylon, Indonesia, Japan, the Republic of Korea, Philippines and Thailand in January 1971.

#### Waste management

101. Public concern about industrial pollution of the environment has had a considerable impact upon nuclear power programmes in some of the main industrial countries. At the international level this concern has been reflected in the interest taken by other organizations in problems relating to the disposal of industrial wastes including nuclear waste; for instance by WHO, UNSCEAR, the groups concerned with the preparation for the United Nations Conference on the Human Environment, to be held at Stockholm in 1972, and by the United Nations committees discussing the sea bed and the ocean floor. It seems likely that the question will also be taken up at the United Nations Conference on the Law of the Sea in 1973.

102. Against this background, the Agency's programmes on waste management are receiving increasing attention. Amongst the main activities undertaken during the period covered by this report were the following:

- (a) A symposium on environmental aspects of nuclear power stations (United Nations, August 1970). This large symposium, held in co-operation with the United States Atomic Energy Commission, attracted wide popular as well as scientific interest and provided an opportunity for a comprehensive review of all aspects of the production of nuclear power that might have an effect on environment. The main conclusion of the symposium was that nuclear power stations contribute far less to environmental pollution than other forms of thermal power production. This has been due in part to the absence of any combustion releases (smoke, soot, particles, etc.) from nuclear plants but also to the care that the nuclear industry has taken in designing its installations to contain radioactivity safely, as a result of which the radioactive "dose" released to the public is trivial in comparison with natural radioactivity;
- (b) A symposium on the management of low- and intermediate-level radioactive wastes (Aix-en-Provence, France, September 1970) in co-operation with ENEA. This symposium reviewed operating experience in the management of such waste and the policies followed by Governments as well as the impact of radioactive waste disposal upon the environment. The symposium closed with a panel review in which it was noted that radioactive waste management had improved considerably over the past 25 years, that great care is exercised before radioactive waste is released to the environment, and international collaboration in the disposal of waste is indicated. At the same time a group of consultants met to review policies and practices followed in managing high-level radioactive wastes from spent fuel reprocessing plants and prepared a report on the subject for the guidance of the Agency and its Member States; and



- (c) A panel on the control of iodine and other constituents of airborne radioactive waste (Vienna, October 1970).

103. It seems likely that international action to control industrial pollution may deal first with the conservation of the seas and oceans. Since its inception, the Agency has been concerned with the control of radioactive contamination of the oceans that might arise from the peaceful uses of atomic energy. A step forward was taken in November 1970 when a panel, convened to prepare a report on the principles for limiting the release of radioactive wastes, recommended the establishment by the Agency of an international register of all substantial releases of radioactive wastes into the seas and oceans. In co-operation with WHO the Agency is also considering a formal proposal to become a central repository of data on radioactivity released into the environment as a whole in connection with the civil uses of atomic energy.

#### Nuclear safety

104. Missions were sent to Mexico in July and to Chile in August 1970 to assist the Governments concerned to select sites for a projected nuclear power plant and a projected dual-purpose nuclear desalting plant respectively. In November/December 1970 a mission reviewed the safety of the Chin-Shan Unit I nuclear power plant in China.

INFORMATION AND TECHNICAL SERVICES

The International Nuclear Information System (INIS)

105. By June 1971, 39 countries and 11 international organizations were participating in INIS. During the first experimental year of the operation of INIS (May 1970 to June 1971) data on 8739 items of nuclear science information were distributed to participants.

106. In November 1970 a panel on the general development pattern of INIS recommended that the initial limited subject scope of the system be retained until the end of 1971. The panel also considered the first INIS thesaurus issued in October 1970 and prepared under a six-month contract between the Agency and EURATOM. The panel recommended that responsibility for further development of the thesaurus should lie with the Agency and that any major changes should be considered by a working group in which EURATOM would participate. It was also agreed that FAO, UNESCO and WHO as well as OPANAL would take part in INIS; ENEA would continue its study of ways in which it could contribute to the system and CERN would take part if the subject scope were expanded to include high energy physics.

107. Two ad hoc study groups on INIS met in February 1971: the first to consider the development of the thesaurus, and the second the items covered by the subject scope and their descriptions.

108. At its meetings in February 1971 the Board approved the appointment of seven persons nominated by the Director General to serve as members of the INIS Advisory Committee; the Committee will meet in November 1971. The work of the Advisory Committee will take account of the examination of the service in the Administrative and Budgetary Committee of the Board in April 1971 when a number of suggestions for improving the service technically and economically were put forward.

109. With a view to helping developing countries to take an active part in INIS a preliminary training seminar was held at Vienna in September and a regional seminar at Bombay from 23 November to 11 December 1970. A further regional seminar for Latin American participants will be held during 1971.

Computer services

110. Since March 1968, by arrangement with ENEA, the Agency has provided programmes from ENEA's computer programme library at Ispra, Italy, to Member States that are not members of ENEA. During 1970, 100 programmes and reports were sent to non-ENEA countries, and 60 programmes were donated by such countries to the library.

111. The total use of the Agency's computer has increased from 290 hours per month in June 1970 to 400 hours a month by June 1971. During the same period, the share of the Agency's administrative services in the use of the computer declined from 36% to about 31%; that of UNIDO increased from 12% to over 20%; and that of INIS from 13% to 16%.

Scientific meetings

112. Comparative information for 1969-70 and 1970-71 about participation in Agency conferences, symposia and seminars is given in the following table.

Table 17

## Conferences, symposia and seminars

Item	1969-70	1970-71
Meetings	13	16
Participants	2225	2686
Countries taking part	67	65
Papers presented	710	784

113. Preparations for the Fourth International Conference on the Peaceful Uses of Atomic Energy to be held in Geneva from 6 to 16 September 1971 are well advanced. The United Nations Scientific Advisory Committee has recommended that the theme should be "Benefits for mankind from the peaceful uses of atomic energy". The Secretary-General has limited the number of papers that may be accepted to about 500, 40% less than the number accepted at the Third Conference in 1964. By 30 June 1971 50 countries and 11 international organizations had submitted papers. Twenty-three scientific secretaries have been appointed of which 16 are members of the staff of the Agency.

Publications

114. The relative share of various programmes in the publications issued is shown in the following table.

Table 18

## Publications

Subject	1968 %	1969 %	1970 %
Nuclear power and reactors	25	14	13.5
Nuclear research	20	29	14.5
Health, safety and waste management	9.5	8	14
Food and agriculture	10	11.5	7.5
Life sciences	6.5	9.5	5
Theoretical physics	3.5	4	3.5
Public information	4	4	4
References and miscellaneous	21.5	20	38

115. Revenues from the sale of publications and related material amounted to \$221 350 in 1970, compared with \$165 855 in 1969. The commercial value of publications distributed free to Member States increased by \$30 000 to \$480 000.

Other activities

116. The holdings of the Library and its activities are summarized in the following tables.

Table 19  
Library holdings

Holdings	June 1970	June 1971
Books and bound periodicals	32 616	34 845
Technical reports (microfiche, hard copy)	123 692	141 088
Periodical subscriptions	1 297	1 361
Films	468	483

Table 20  
Library services

Services	July 1969- June 1970	July 1970- June 1971
Loans to Member States (Books and periodicals)	541	473
Circulation within Secretariat (Books, documents, periodicals, microfiche and other loans)	45 839	50 382
Pages of Xerox copies	71 960	84 169
Film loans to Member States	953	928

## SAFEGUARDS

General

117. The work of the Safeguards Committee (1970) established by the Board in April 1970 has been referred to in the Introduction. The following are some of the principal recommendations of the Committee, which the Board has authorized the Director General to follow in negotiating with non-nuclear-weapon States party to NPT:

- (a) Safeguards are to be applied to all nuclear material in all peaceful nuclear activities, but are concerned only with verification that there is no diversion of nuclear material from peaceful uses to nuclear weapons or other nuclear explosive devices. In case nuclear material is to be used in military activities not proscribed by NPT, the State must show clearly that the material in question is not subject to "peaceful use only" requirements;
- (b) The State must make provision for a system of accounting for and control of all nuclear material subject to safeguards. Safeguards are to be applied in such a way that the Agency may verify, in ascertaining that there has been no diversion, findings of the State's system. The Agency's verification shall include, inter alia, independent measurements and observations conducted in accordance with procedures laid down in detail in the agreement;
- (c) The starting point for the application of safeguards is set at a stage in the fuel cycle when nuclear material reaches such purity and composition as to make it suitable for nuclear use;
- (d) Safeguards terminate when nuclear material is transferred out of the State and when the recipient State has assumed responsibility for the material;
- (e) The requirements for reports to the Agency on safeguarded nuclear material are set forth in detail;
- (f) The transmission to the Agency of commercially sensitive information is limited to the strict minimum needed for safeguarding nuclear material;
- (g) Routine inspections are confined to predetermined strategic points and key measurements points and provision is made for the installation and use of the Agency's measuring instruments;
- (h) The inspection effort that may be devoted to the various categories of facilities has been defined; and
- (i) Criteria have been set to enable the Agency to determine the actual routine inspection effort to be applied.

The detailed implications of the Committee's work are the subject of continuing technical studies within the Secretariat.

118. The above examples show that the Agency has, as requested by the General Assembly, carefully considered the relevant recommendations of the Conference of Non-Nuclear-Weapon States and taken account of them.

119. The Committee also paid considerable attention to the question of how safeguards should be financed in future. The solution it recommended, which was subsequently endorsed by the Board, was that the costs the Agency incurred in applying safeguards in Member States should continue to be met from its Regular Budget, but that the method of assessing Members for contributions thereto should be adjusted so as to limit the share of those costs borne by Members having low per capita net national products. [ 14 ]

120. By 30 June 1971 29 States were in the process of negotiating safeguards agreements with the Agency pursuant to Article III of NPT. This will lead to a certain increase of the Agency's safeguards work in 1972; further expansion of this work will obviously depend upon the progress made in the ratification of NPT.

121. By Resolution 2261 B (XXV), the United Nations General Assembly asked the Agency to pay attention to the safeguards required with respect to new techniques for uranium enrichment, and to inform the General Assembly at its twenty-sixth session of its consideration of this subject.

122. The following observations are made in response to the resolution:

- (a) Current forecasts foresee a rapid increase in the demand for enriched uranium for power reactors during the next two decades and it seems clear that this will require an extension of uranium enrichment capacity which is at this time still substantially confined to the five nuclear-weapon States;
- (b) Thus, for instance, three western European countries (of which one is a nuclear-weapon State) are jointly engaged in a uranium enrichment project utilizing gas centrifuge technology. Another western European country is engaged in a detailed study of plans for a western European enrichment project. There are other indications that gaseous diffusion capacity may be extended commercially by affiliation between industries in different countries. One Member State has announced that it has developed an entirely new process for uranium enrichment, but no details have yet been disclosed, while in another State experimental work using the conditions prevailing in a plasma is being carried out to separate uranium isotopes;
- (c) Summing up, during this decade, enriched uranium will become a commodity of even greater commercial importance and it seems likely that especially those industrial countries that have rapidly growing nuclear power programmes will become increasingly interested in obtaining individually, or jointly with others, the capacity to help meet their enriched uranium fuel requirements;
- (d) Until now Agency safeguards have not been applied in uranium enrichment plants. In due course, however, and particularly as a result of NPT, it is expected that Agency safeguards will be applied to nuclear material in all types of peaceful nuclear activities: enrichment plants as well as reactors, fabrication plants and reprocessing plants, etc.;
- (e) The structure and content of agreements recommended by the Committee were formulated on the basis of experience in applying safeguards to nuclear material in facilities other than enrichment plants, but the Committee was of the view that its recommendations could also provide an adequate

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[ 14 ] See also para. 4 above.

framework for agreements covering such plants. Nevertheless, the Secretariat is continuing to follow the developments described above; it is also continuing its studies of the possible implications of new techniques for uranium enrichment with a view to determining the effect they might have on the application of safeguards in practice.

#### Implementation of Agency safeguards

123. During the period covered by this report, the Board approved:

- (a) A Safeguards Transfer Agreement in connection with the bilateral co-operation agreement between the Governments of China and the United States;
- (b) A Safeguards Transfer Agreement in connection with the bilateral co-operation agreement between the Governments of the Republic of Korea and the United States;
- (c) A Safeguards Transfer Agreement in connection with the bilateral co-operation agreement between the Governments of Canada and India;
- (d) An Agreement between the Government of Finland and the Agency on safeguards in connection with NPT; and
- (e) An Agreement between the Government of Austria and the Agency on safeguards in connection with NPT.

Table 21 at the end of this section shows the total number of safeguards agreements approved by the Board until 30 June 1971 and the countries involved.

124. Table 22 lists the facilities containing nuclear material at present under Agency safeguards; [ 15 ] the breakdown on 30 June 1971 as compared to 30 June 1970 is as follows:

	<u>30 June 1970</u>	<u>30 June 1971</u>
Nuclear power stations	10	9 [ 15 ]
Other reactors	68	66 [ 15 ]
Conversion plants, fabrication plants and fuel reprocessing plants	4	10
Other separate accountability areas	74	85

125. As of 31 December 1970 the following quantities of nuclear material were under Agency safeguards:

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[ 15 ] The termination of the safeguards agreement with the United States has resulted in the Yankee Nuclear Power Station and two research reactors being taken off the list of power stations and other reactors under safeguards. In addition, one research reactor in Japan has closed down. One more research reactor in China has come under safeguards.

	<u>Total element</u>	<u>Fissionable isotope</u>
(a) Special fissionable material		
Plutonium	770 kg	
Enriched uranium of 20% enrichment and above	2 863 kg	872 kg
Enriched uranium below 20% enrichment	240 505 kg	5 216 kg
(b) Source material		
Natural uranium	909 312 kg	
Depleted uranium	236 477 kg	
Thorium	261 kg	

126. During the period covered by this report 184 inspections were made in 18 Member States compared with 139 inspections in 17 Member States during the preceding 12 months. Ten pre-operational visits were made in seven Member States compared with seven pre-operational visits in five Member States in the previous reporting period.

#### Notification of transfers of nuclear materials

127. Notifications of international transfers of nuclear materials which are not under Agency safeguards were received from the following countries for the periods shown against them:

Canada	1 July 1969 to 30 June 1970
Norway	1 January 1970 to 30 June 1970
United States	1 July 1969 to 30 June 1970.

#### Research and development programme

128. During the year further progress has been made in improving and simplifying the Agency's safeguards procedures. A summary of some of the main work is given in the following paragraphs.

129. A research co-ordination meeting on the use of instrumentation techniques to determine the quantity and flow of nuclear material in reprocessing plants was held at Vienna from 14 to 18 December 1970. Participants reported on the present stage of development of various techniques for measurements, as well as on promising new surveillance techniques and made recommendations about those to which priority should be given in the Agency's research and development programme.

130. A Working Group to consider guidelines for the physical protection of nuclear material met at Vienna from 14 to 18 June 1971. Twenty participants and observers from 13 countries and one international organization attended and made a well-defined set of suggestions, including a programme for further work in this field.

131. Systems analysis studies are enabling the Agency to estimate more accurately the safeguards tasks that lie ahead. The studies have included the following subjects:



- (a) Detailed estimates of the quantities and distribution of nuclear material in the fuel cycle of non-nuclear-weapon States during the period 1970-80;
- (b) Future requirements for staff and finances;
- (c) The limits of precision of the measurement of nuclear material at various steps in the fuel cycle;
- (d) Standardization of terminology used in safeguards and in nuclear materials accounting; and
- (e) Evaluation of standard reporting requirements for safeguards purposes and studies on the automatic processing of the reported information.

132. Work has also continued on developing safeguards instruments. Inspectors have been able to make use of some new devices, such as portable gamma spectrometers to measure highly enriched fuel elements. Seals have been applied in some reactors. A promising method has been demonstrated for determining burn-up in spent fuel elements in the pond of the reprocessing plant: a simple mechanical device has been used to scan fuel elements and a germanium-lithium spectrometer has been used to make gamma measurements. Portable safeguards instruments, e. g. neutron and gamma detectors, including an advanced model of a neutron coincidence counter, obtained on loan from the Arms Control and Disarmament Agency, United States, were used by the Agency at the Centre d'étude de l'énergie nucléaire, Mol, Belgium, for assay of the nuclear material contained in fuel elements. The Agency's IBM 360/30 computer is being used for processing of data obtained by non-destructive gamma measurements of fuel materials.

133. Work in the field test programme has included the following projects:

- (a) The results of "developmental" inspections at the Nuclear Fuel Services reprocessing plant in the United States have been evaluated and general procedures for applying safeguards to such plants have been drawn up;
- (b) A general study of safeguards procedures for light water reactors has been made on the basis of experience gained in normal inspections. A new approach to safeguards for such facilities is being tested at the Novo-Voronezh station in the Soviet Union;
- (c) Using the experience gained from "developmental" inspections at a "Magnox" type power station (Bradwell, United Kingdom), and a fast critical facility (Zebra, United Kingdom) procedures for the verification of inventories have been drawn up and surveillance techniques have been reviewed;
- (d) Much valuable experience in determining characteristics of nuclear material by measuring gamma irradiation from spent fuel and in analysing plutonium and uranium has been gained as a result of the Agency's participation in an integral experiment carried out at the Eurochemic reprocessing plant at Mol (Belgium) by the Nuclear Research Centre of Karlsruhe (Federal Republic of Germany);
- (e) An integral test has been made at the Westinghouse Nuclear Fuel Division uranium oxide conversion and fabrication plant at Columbia, S. C. (United States). Full safeguards procedures were applied during the test. The experience gained has been valuable in developing new safeguards procedures applying instruments and using statistical techniques for verification purposes;

- (f) The Agency is currently participating in another integrated safeguards experiment designed to develop procedures for safeguarding plutonium and for applying safeguards in mixed oxide fuel fabrication plants. The experiment is sponsored by the United States Atomic Energy Commission and is being carried out by the Brookhaven National Laboratory and the United States National Bureau of Standards and the Plutonium Fuel Development Group of the General Electric Corporation; and
- (g) Surveillance cameras, which take photographs of selected areas automatically at fixed intervals, have been procured by the Agency and are being tested at several power reactor sites.

134. Twenty research and technical contracts for the development of safeguards methods, techniques and instrumentation were current during the period covered by this report. Table 23 at the end of this section gives particulars of the institutes to which the contracts were awarded, the title of the contract and the amount of the Agency's contribution to each. The total value of the contracts amounts to \$167 200.

Table 21

Safeguards Agreements approved by the Board of Governors  
(except those that have expired or been cancelled)

State(s)	Subject	Entry into force	INFCIRC
<u>Project Agreements</u>			
Argentina	Siemens SUR-100	13 Mar 1970	143
	RAEP Reactor	1 Dec 1964	62
Chile	Herald Reactor	19 Dec 1969	137
Congo, Democratic Republic of the	TRICO Reactor	27 Jun 1962	37
Finland	F1R-1 Reactor	30 Dec 1960	24
	FINN sub-critical assembly	30 Jul 1963	53
Indonesia	Additional core-load for Triga Reactor	19 Dec 1969	136
Iran	UTRR Reactor	10 May 1967	97
Japan	JRR-3	24 Mar 1959	3
Pakistan	PRR Reactor	5 Mar 1962	34
	Booster rods for KANUPP	17 Jun 1968	116
Philippines	PRR-1 Reactor	28 Sep 1966	88
Spain	Coral I Reactor	23 Jun 1967	99
Uruguay	URR Reactor	24 Sep 1965	67
Viet-Nam	VNR-1 Reactor	16 Oct 1967	106
Yugoslavia	TRIGA II Reactor	4 Oct 1961	32
<u>Transfer Agreements</u> (Bilateral co-operation agreements between the indicated States)			
Argentina/USA		25 Jul 1969	130
Australia/USA		26 Sep 1966	91
Austria/USA		24 Jan 1970	152
Brazil/USA		31 Oct 1968	110
Canada/Japan		12 Nov 1969	85
Canada/India			
China/USA <sup>a/</sup>		29 Oct 1965	72
Colombia/USA		9 Dec 1970	144
Denmark/UK		23 Jun 1965	63
Denmark/USA		29 Feb 1968	112
Greece/USA		13 Jan 1966	78
India/USA		27 Jan 1971	
Indonesia/USA		6 Dec 1967	100
Iran/USA		20 Aug 1969	127
Israel/USA		15 Jun 1966	84
Japan/USA		10 Jul 1968	119
Japan/UK		15 Oct 1968	125
Korea/USA <sup>a/</sup>		5 Jan 1968	111
Pakistan/Canada		17 Oct 1969	135
Philippines/USA		19 Jul 1968	120
Portugal/USA		19 Jul 1969	131
South Africa/USA		26 Jul 1967	98
Spain/USA		9 Dec 1966	92
Thailand/USA		10 Sep 1965	68
Turkey/USA		5 Jun 1969	123
Venezuela/USA		27 Mar 1968	122
Viet-Nam/USA		25 Oct 1965	71
<u>Unilateral submissions</u>			
China	Taiwan Research Reactor Facility	13 Oct 1969	133
Mexico	All nuclear activities	6 Sep 1968	118
United Kingdom	Bradwell facility	1 Sep 1966	86
<u>Agreements under NPT <sup>b/</sup></u>			
Austria			
Finland			

<sup>a/</sup> This agreement will be replaced by a new one which has already been approved by the Board.

<sup>b/</sup> Once these agreements have entered into force, safeguards under the above-mentioned agreements with the respective State will be suspended.

Table 22

Nuclear installations under Agency safeguards or containing safeguarded material under agreements approved by the Board of Governors

A. Reactors<sup>a/</sup> other than power reactors

Member State	Name of reactor	Location	Type	Capacity MW(th)	In operation	Maximum routine inspections per year <sup>b/</sup>
Argentina	RA-0/Argentine Reactor 0	Constituyentes	Tank	.00	x	0
	RA-1/Argentine Reactor 1	Constituyentes	Argonaut	.10	x	0
	RA-2/Argentine Reactor 2	Constituyentes	Argonaut	.00	x	1
	RA-3/Argentine Reactor 3	Ezeiza	Pool-tank	5.00	x	2
Australia	HIFAR	Lucas Heights	Tank	10.00	x	5
	MOATA	Lucas Heights	Argonaut	.01	x	3
Austria	SAR/Argonaut Graz Research Reactor	Graz	Argonaut	.001	x	1
	AUSTRIAN TRIGA MARK II Research Reactor	Vienna	Triga II	.25	x	0
	ASTRA	Seibersdorf	Pool	12.00	x	3
Brazil	IEAR-1	São Paulo	Pool	5.00	x	2
	TRIGA I	Belo Horizonte	Triga I	.03	x	0
	ARGONAUT	Rio de Janeiro	Argonaut	.01	x	0
Colombia	IAN-R1	Bogotá	Light-water	.10	x	0
Chile	Herald Reactor	Santiago	Herald	5.00		2
China	THOR/Tsing Hua Open Pool Reactor	Hsin-chu	Pool	1.00	x	1
	Taiwan Research Reactor Facility	Huaitzupu	NRX	40.00		
	ZPRL/Zero Power Reactor	Lung-Tan	Pool	.00	x	0
Congo, Democratic Republic of the	TRICO	Kinshasa	Triga I	.05	x	0
Denmark	DR-1	Risø	Homogeneous	.002	x	1
	DR-2	Risø	Pool	5.00	x	2
	DR-3	Risø	Tank	10.00	x	3
Finland	FiR-1	Otaniemi	Triga II	.25	x	0
Greece	GRR/Greek Research Reactor	Athens	Pool	3.00	x	2
Indonesia	TRIGA II/Bandung	Bandung	Triga II	.25	x	1
Iran	UTRR	Teheran	Pool	5.00	x	1
Israel	IRR-1	Yaven	Pool	5.00	x	4
Japan	JRR-2/Japan Research Reactor 2	Tokai-mura	Tank	10.00	x	3
	JRR-3/Japan Research Reactor 3	Tokai-mura	Tank	10.00	x	1
	JRR-4/Japan Research Reactor 4	Tokai-mura	Pool	1.00	x	1
	JPDR/Japan Power Demonstration Reactor	Tokai-mura	Boiling-water	90.00	Under recon- struction	3
	SHCA/Semi- Homogeneous Critical Assembly	Tokai-mura	Crit. Fac.	.00	x	1
	AHCF/Aqueous Homogeneous Critical Facility	Tokai-mura	Crit. Fac.	.00	x	0
	TCA Tank-type Critical Assembly	Tokai-mura	Crit. Fac.	.00	x	0

Member State	Name of reactor	Location	Type	Capacity MW(th)	In operation	Maximum routine inspections per year <sup>b/</sup>	
Japan (cont.)	Sumitomo Critical Assembly	Tokai-mura	Crit. Fac.	.00	x	0	
	Rikkyo University Research Reactor	Yokosuka-shi	Triga II	.10	x	0	
	Musashi College of Technology Research Reactor	Kawasaki-shi	Triga II	.10	x	0	
	Kinki University Research Reactor	Fuse-shi	UTR-B	.00	x	1	
	TTR/Toshiba Training Reactor	Kawasaki-shi	Pool	.03	x	0	
	HTR/Hitachi Training Reactor	Kawasaki-shi	Pool	.10	x	1	
	HCA/Hitachi Critical Assembly	Kawasaki-shi	Crit. Fac.	.10	x	0	
	Nippon Atomic Industry Group Critical Assembly	Kawasaki-shi	Crit. Fac.	.00	x	1	
	KUR/Kyoto University Research Reactor	Kumatori-cho	Pool	1.00	x	2	
	JMTR-CA/Japan Material Testing Reactor Critical Facility	Tokai-mura	Crit. Fac.	.00	x	2	
	FCA/Fast Critical Assembly	Tokai-mura	Crit. Fac.	.00	x	5	
	JMTR/Japan	Orai	Tank	50.00	x	3	
	Mitsubishi Critical Facility	Ohmiya-Saitama	Tank	.00	x		
	Deuterium Critical Assembly	Orai-Ibarachi	Tank	.00			
	Korea, Republic of	TRIGA II/Seoul	Seoul	Triga II	.10	x	0
	Mexico	National Institute of Nuclear Energy Reactor	Mexico City	Triga III	1.00	x	0
	Pakistan	PRR/Pakistan Research Reactor	Rawalpindi	Pool	5.00	x	1
Philippines	PRR-1/Philippine Research Reactor	Diliman	Pool	1.00	x	1	
Portugal	RPI/Portuguese Research Reactor	Sacavem	Pool	1.00	x	1	
South Africa	SAFARI-I	Pelindaba	Tank	20.00	x	5	
	Critical Assembly	Pelindaba	Crit. Fac.	.00	x	1	
Spain	ARBI	Bilbao	Argonaut	.01	x	0	
	ARGOS	Barcelona	Argonaut	.01	x	0	
	CORAL I	Madrid	Zero energy fast reactor	.00		5	
	JEN I	Madrid	Pool	3.00	x)	1	
	JEN II	Madrid	Pool	.00	x)		
Thailand	TRR-1/Thai Research Reactor 1	Bangkok	Pool	1.00	x	1	
Turkey	TR-1	Istanbul	Pool	1.00	x	1	
United Kingdom	ZEBRA/Fast Critical Assembly	Winfrith	Crit. Fac.	.00	x	A	
Uruguay	URR/Uruguay Research Reactor	Montevideo	Lockheed	.10		0	
Venezuela	RV-1	Caracas	Pool	3.00	x	0	
Viet-Nam	VNR-1/Viet-Nam Research Reactor 1	Dalat	Triga II	.25	x	0	
Yugoslavia	TRIGA II/Yugoslav Research Reactor	Ljubljana	Triga II	.25	x	0	

B. Nuclear power stations

Member State	Name of power station	Location	Type	Capacity MW(e)	In operation	Maximum routine inspections per year <sup>b/</sup>
India	Tarapur Atomic Power Station	Tarapur	BWR	380	x	A
Japan	Tokai-mura Nuclear Power Station	Tokai-mura	Magnox	185	x	A
	Tsuruga Nuclear Power Station	Tsuruga	BWR	320	x	A
	Mihama-1 Nuclear Power Station	Mihama-Fukui	PWR	340	x	A
	Fukushima-1 Nuclear Power Station	Ohkumo-Fukushima	BWR	460	x	A
Pakistan	Karachi Nuclear Power Project	Karachi	Candu	137		A
Spain	José Cabrera Nuclear Power Station	Almonacid de Zorita	PWR	156	x	A
	Santa Maria de Garona Nuclear Power Station	Santander	BWR	450		A
United Kingdom	Bradwell Nuclear Power Station	Bradwell	Magnox	300	x	A

C. Conversion plants, fabrication plants and chemical reprocessing plants

Pilot Fuel Reprocessing Plant, Ezeiza, Argentina

Pilot Fuel Fabrication Plant, Constituyentes, Argentina

Fabrication Facility, Metallurgy Department, Instituto de Energia Atomica, São Paulo, Brazil

Fuel Fabrication Plant, Risø, Denmark

Sumitomo Electric Industry (Kumatori-1), Japan

Furukawa Electric Industry (Takayama-1), Japan

Mitsubishi Atomic Power Industry (Ohmiya-1), Japan

Japan Nuclear Fuel Corporation, Japan

Mitsubishi-Westinghouse, Japan

Pilot Reprocessing Plant, Juan Vigon Centre, Madrid, Spain

a/ As defined in documents INFCIRC/26, Part II, para. 14 and INFCIRC/66/Rev.2, Part IV, para. 80.

b/ A = Access at all times.

Table 23

## Contracts for safeguards research and development

Duration of contract	Title	Institute	Agency contribution in dollars
1970-71	Integral experiments restricted at key points of control for highly enriched fuel element cycle from fabrication plant to dissolver of reprocessing plant	Centre d'études de l'énergie nucléaire Brussels	8 000
1971-72	Development of a method for continuous measurement of uranium inventory of process vessels	Eurochemic Mol, Belgium	3 000
1970-71	Verification of reprocessing input measurements	Eurochemic Mol, Belgium	4 000
1971	Determination of $^{235}\text{U}$ enrichment in unirradiated uranium bearing streams	Institute of Physics Bulgarian Academy of Science Sofia	6 500
1971	Development and fabrication of probes and auxiliary equipment for measurement of plutonium using neutron coincidence counting techniques	Institute of Physics Bulgarian Academy of Science Sofia	4 200
1971	Safeguards study of the Canadian Westinghouse Fuel Fabrication Plant	Canadian Westinghouse Ltd. Hamilton, Ontario, Canada	17 000
1971-72	Safeguarding the input to a fuel reprocessing plant	Institut für Angewandte Reaktorphysik Kernforschungszentrum Karlsruhe, Federal Republic of Germany	8 000
1970-71	Study of non-destructive measurement method for highly enriched U-Al alloy plate fuel	Sumitomo Electric Industries, Ltd. Japan	-
1971-72	Evaluation of operational data on a Swedish low enrichment uranium fuel fabrication plant	ASEA-ATOM Fuel Fabrication Plant Västerås, Sweden	2 500

Duration of contract	Title	Institute	Agency contribution in dollars
1969-70	Determination of the accumulation of transuranium elements in spent fuel from the First Atomic Power Station	Institute of Physics and Power Engineering Obninsk, Soviet Union	-
1969-71	Chromatographic separation of uranium and plutonium from reprocessing plant liquid waste followed by automatic measurement of plutonium amounts by probe type alfa detector and the uranium by photometry methods	Vernadsky Institute Moscow	25 000
1971	Measurement of neutron decay constants in a highly critical reactor as a safe-guards method	Nuclear Energetics Minsk, and Institute of Physics Kiev, Soviet Union	-
1971-72	Integral safeguards experiment at the Novo-Voronezh LWR Power Reactor Plant	I. V. Kurchatov Institute of Atomic Energy and Novo-Voronezh Nuclear Power Station Soviet Union	40 000
1969	The examination of possible design criteria which will facilitate the application of safeguards	United Kingdom Atomic Energy Authority Risley, United Kingdom	5 000
1970-71	Nuclear material transfer monitor	United Kingdom Atomic Energy Authority Risley, United Kingdom	4 000
1971	Development of an application technique to verify the fissile material of irradiated fuel in a zero energy reactor	United Kingdom Atomic Energy Authority Reactor Group United Kingdom	5 000
1971	Development of a device and application technique designed to reveal tampering with reactor fuel elements	Battelle Northwest Battelle Memorial Institute Richland, Washington United States	25 000
1971	Development of an information system for nuclear materials assay technique	JRB Associates La Jolla, California United States	5 000



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Duration of contract	Title	Institute	Agency contribution in dollars
1971	Feasibility study of safe- guards methods and techniques applicable to the Midwest Recovery Plant (MFRP)	General Electric Co. United States	5 000
1971	Tamper-resistant instrumentation for a chemical reprocessing plant	Braddock, Dunn and McDonald, Inc. United States	20 000

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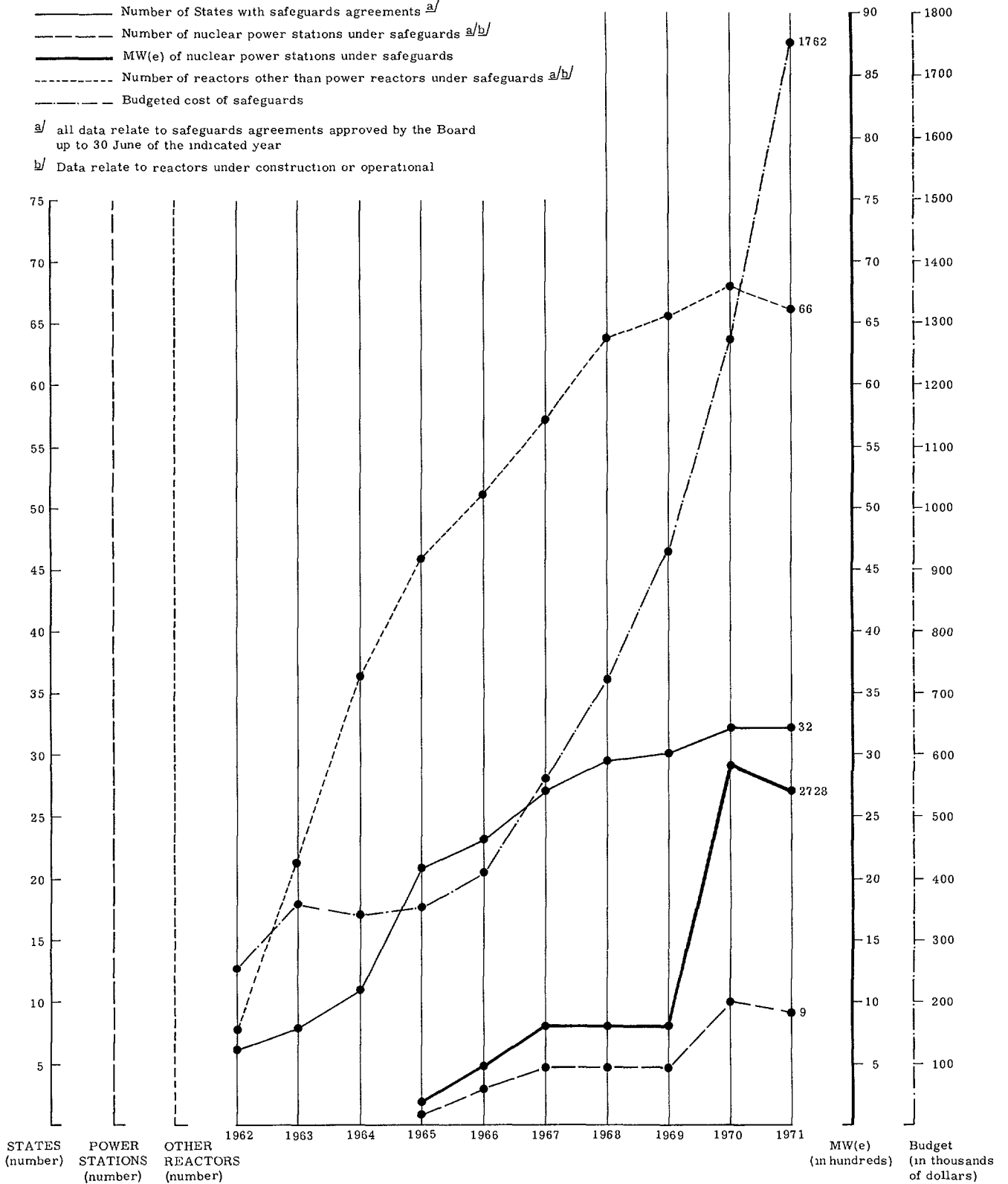
# GROWTH OF AGENCY SAFEGUARDS

LEGEND

- Number of States with safeguards agreements <sup>a/</sup>
- - - Number of nuclear power stations under safeguards <sup>a/b/</sup>
- MW(e) of nuclear power stations under safeguards
- - - - - Number of reactors other than power reactors under safeguards <sup>a/b/</sup>
- - - - - Budgeted cost of safeguards

<sup>a/</sup> all data relate to safeguards agreements approved by the Board up to 30 June of the indicated year

<sup>b/</sup> Data relate to reactors under construction or operational



## ADMINISTRATION

## EXTERNAL RELATIONS AND LEGAL MATTERS

135. The main developments of an external relations or legal character during the period covered by this report have been referred to in the Introduction and in the appropriate programme sections. Much of the Secretariat's work under this heading has been concerned with studies, consultations and negotiations relating to NPT.

136. Early last June the Board discussed the decision taken by UNSCEAR last September, which the General Assembly later endorsed, to give more attention to environmental contamination arising from the use of nuclear energy for peaceful purposes and particularly for the generation of electric power [16]. The Board felt that this development required further strengthening of the Agency's working relations with UNSCEAR, a number of Governments taking the position that international responsibility for collecting information relating to the impact on the environment of the peaceful use of nuclear energy should be increasingly concentrated in the Agency, so as to avoid duplication of effort. At UNSCEAR's session later in June the first consultations were held about means of intensifying co-operation, particularly in the collection of information. [17]

137. In order to reduce expenditure on documentation, the Board decided last February that it would be desirable for a single report to be prepared each year which would serve the purposes of informing the General Conference and the relevant organs of the United Nations as well about the Agency's activities. It accordingly asked the Director General to undertake the necessary consultations to that end. At the same time the Board decided to discontinue the reports on developments in the Agency's work which the Director General had hitherto been required to make to it periodically.

138. At the invitation of the Director General, the Advisory Committee on Administrative and Budgetary Questions of the United Nations met at the Agency's Headquarters in May 1971. It reviewed the administrative and management procedures followed in preparing and carrying out the programme and budget of the Agency, as well as questions arising out of the co-ordination of the Agency's work with that of other organizations in the United Nations system.

139. The Agency is taking an appropriate part in the preparation of the United Nations Conference on the Human Environment (Stockholm, 5 to 16 June 1972). Together with WHO it will contribute a review of the future role of nuclear power and associated environmental problems in which the effects of nuclear and conventional plants on the environment will be compared. Another contribution will deal with the value of nuclear techniques in managing the environment by preserving and developing water and agricultural resources and controlling various chemical pollutants. The Conference will make recommendations for international action on environmental problems and the Agency has also made proposals in this connection.

140. In December 1970 the Austrian authorities concerned reached a final decision on the selection of a design for the future International Centre in Vienna, which will include the permanent Headquarters of the Agency and UNIDO. The project submitted by Mr. Johann Staber of Austria was selected. According to information received by the Secretariat it is expected that the Agency's permanent Headquarters building will be completed in 1976/77.

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[16] See paras 7-9 of UNSCEAR's report to the General Assembly in United Nations document A/8078 and the Assembly's Resolution 2623 (XXV).

[17] In this connection see para. 103 above dealing with a register of disposals of radioactive waste.

141. Since the last report to the General Conference Indonesia, Greece, Poland and Romania have accepted the Agreement on the Privileges and Immunities of the Agency[ 18] thus raising to 39 the number of Member States party to the Agreement.

142. The Agency has continued to provide advice to Member States (Brazil, Bulgaria, Cuba, Kuwait, Pakistan and Peru) on problems of nuclear legislation and to assist them to train experts on this subject. A training course on the legal aspects of nuclear energy in Athens in December 1970 was attended by 25 lawyers and scientists from 13 Member States in Africa, the Middle East and Eastern Europe.

143. The Standing Committee on Civil Liability for Nuclear Damage[ 19] met at Headquarters from 1 to 4 June. It made recommendations to the Director General for limits on the small quantities of nuclear material which could be excluded from the application of the Vienna Convention on Civil Liability for Nuclear Damage, to replace corresponding limits which the Board established in 1964. The Committee also discussed a number of other matters, in particular the problems raised by divergencies between international conventions on civil liability for nuclear damage and maritime conventions on third party liability.

#### PERSONNEL

144. On 30 June 1971 the Secretariat had 348 staff members in the Professional category and above. Of these, 340 held permanent or fixed-term contracts, seven were serving under Special Service Agreements and one was seconded to a United Nations organization. There were 333 such staff members employed at the Agency's Headquarters, four at Trieste, one at Ispra, Italy, five at Monaco, two at New York, two at Geneva and one in Bangkok. The number of staff members holding posts that were subject to geographical distribution was 287; 55 Member States were represented on the staff. The Secretariat also included 546 General Service staff, 13 of whom were serving in Monaco, 14 at Trieste, two at New York, one at Geneva, as well as 222 staff members in the Maintenance and Operatives Service. The total strength of the staff was thus 1116.

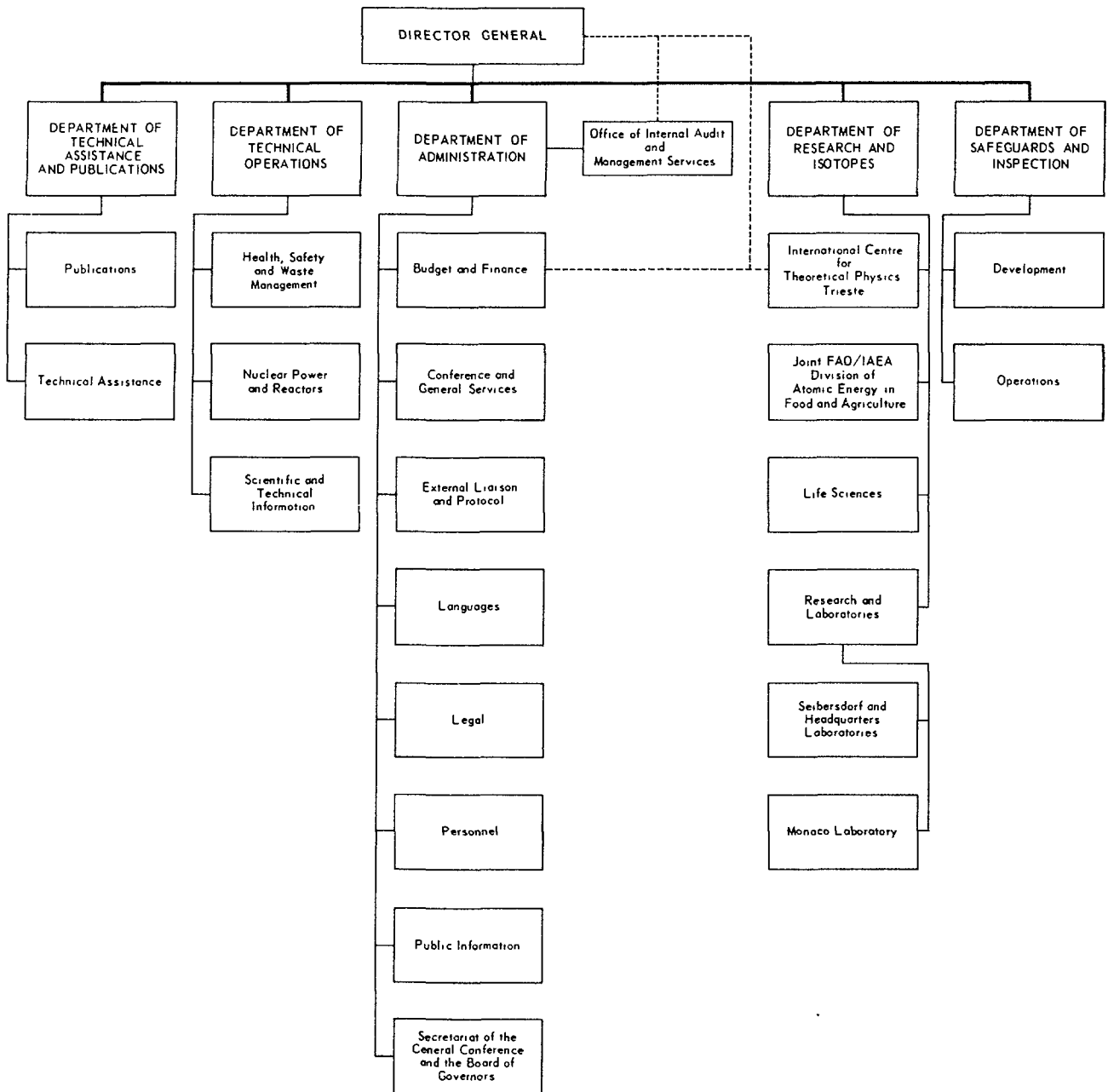
145. The following organizational chart shows the structure of the Secretariat as at 30 June 1971.

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[ 18] INFCIRC/9/Rev.2.

[ 19] Established by the Board in 1963 on the recommendation of the International Conference on Civil Liability for Nuclear Damage.

## Organizational Chart



## FINANCE

Regular Budget

The financial year 1970

146. The assessment of contributions on Member States included in the scale of assessment for 1970 amounted to \$11 853 000. Additional assessment on Ireland, which joined the Agency in 1970 after the scale for 1970 had been established, increased the total by \$17 780 to \$11 870 780.

147. By 31 December 1970, the Agency received contributions towards the Regular Budget for 1970 amounting to \$10 818 133 which represents 91.13% of the total assessed for that appropriation. By 30 June 1971 \$11 062 554 or 93.19% of the 1970 Regular Budget assessment had been received.

148. The Agency's obligations for 1970 amounted to \$12 231 107, which resulted in budgetary savings of \$18 893 from the appropriations for 1970. A further amount of \$57 474 from miscellaneous income brought the total budgetary surplus at 31 December 1970 to \$76 367 as follows:

Budgetary savings:		\$18 893
Contributions assessed on new Member States		17 780
Excess of miscellaneous income over budget:		
Actual miscellaneous income	\$436 694	
Less: budget	<u>397 000</u>	<u>39 694</u>
Budgetary surplus for 1970		<u><u>\$76 367</u></u>

Since contributions in the amount of \$1 052 647 were outstanding from Member States for 1970, there was a provisional cash deficit of \$976 280.

149. Savings under seven appropriation sections totalling \$129 016 were transferred to five other appropriation sections which bore the major impact of salary increases approved in 1970. In addition, an amount of \$81 107 was withdrawn from Section 9 - Contingency extraordinary expenditures - to cover the remaining price and salary increases.

The financial year 1971

150. On 14 December 1970 Nicaragua withdrew from membership of the Agency. As a result of this withdrawal and in accordance with the Agency's Statute the total approved assessment of contributions to Member States was reduced by \$5221 and the Working Capital Fund by \$800.

151. By 30 June 1971 the following advances to the Working Capital Fund and contributions to the Regular Budget for 1971 had been received:

Advances to the Working Capital Fund	\$1 998 400
Contributions to the Regular Budget for 1971	\$4 077 559

By that date Member States had thus paid 99.96% of the total advances due to the Working Capital Fund and 31.25% of the total contributions due to the 1971 Regular Budget.

Operational Budget

152. Although the General Conference at its thirteenth (1969) regular session again established a target of \$2 million for voluntary contributions in 1970, there was a shortfall of approximately \$327 000 in the actual pledges made by Member States. Of a total amount of \$1 672 933 pledged to the General Fund for 1970, \$959 917 had been paid by 31 December 1970. By 30 June 1971 receipts amounted to \$1 572 881 leaving a balance of \$100 052 still to be paid.

153. The total operational obligations incurred during 1970 amounted to \$3 646 784. Unliquidated obligations as at 31 December 1970 including obligations brought forward from the previous years amounted to \$1 364 152.

The Agency's resources in 1970

154. Resources equivalent to more than \$17 897 543 were at the Agency's disposal during 1970 under its own programme, UNDP(TA) and UNDP(SF) accounts and other special projects, including contributions in cash, services and kind. Details concerning these resources are set out in Table 24.

Table 24  
Summary of resources received during 1970<sup>a/</sup>

<u>Administrative Fund</u>	\$	\$	\$
Assessed contributions to the Regular Budget			
Member States included in the scale for 1970	11 853 000		
New Members	<u>17 780</u>	11 870 780	
Actual miscellaneous income		<u>436 694</u>	
Sub-total			12 307 474
<u>General Fund (including Operating Fund I and II)</u>			
Voluntary contributions pledged for 1970		1 672 133	
Miscellaneous income (from investments, Laboratory, local costs, etc.)		547 898	
Special voluntary contributions pledged		<u>289 640</u>	
Sub-total			2 509 671
<u>United Nations Development Programme</u>			
<u>Technical Assistance Account<sup>b/</sup></u>			
Funds allocated in 1970 and miscellaneous income			1 679 963
<u>Special Fund<sup>c/</sup></u>			
Funds allocated in 1970 and miscellaneous income			205 929
Executing Agency Overhead Costs			30 200
<u>Special Accounts</u>			
Swedish International Development Authority Trust Fund			85 668
Central Funds in Trust Technical Assistance Programme to the Democratic Republic of the Congo			158
<u>Financial contributions received towards the costs of conferences, symposia and seminars for 1970</u>			
Amounts pledged			72 898
<u>Contributions in services and in kind<sup>d/</sup></u>			
Type II fellowships awarded <sup>e/</sup>	617 800		
Technical assistance equipment and supplies	231 180		
Laboratory equipment and supplies	102 919		
Library, etc.	3 683		
Special nuclear materials	<u>50 000</u>		
Sub-total			<u>1 005 582</u>
TOTAL			<u><u>17 897 543</u></u>

<sup>a/</sup> See the Agency's accounts for 1970 (GC(XV)/459).

<sup>b/</sup> Ibid., Statement IV.

<sup>c/</sup> Ibid., Statement V and VI.

<sup>d/</sup> Ibid., Schedule G. In addition to monetary funds, contributions in services and kind were at the Agency's disposal. Not listed since not evaluated in dollars are cost-free experts: 305 experts - 2533 man/days in 1970.

<sup>e/</sup> Ibid., Schedule G. The amount shown represents the total value of fellowships offered during the respective year, while many of the fellowships extended over a number of years.



## ANNEX A

## THE BOARD OF GOVERNORS

To 28 September 1970	1970-1971	From 28 September 1970
	Argentina <sup>a/b/</sup>	
	Australia <sup>b/c/</sup>	
	Brazil <sup>c/e/</sup>	Belgium <sup>d/</sup>
	Canada <sup>b/c/</sup>	
Czechoslovak Socialist Republic <sup>f/</sup>		Chile <sup>e/</sup>
	France <sup>b/c/</sup>	Denmark <sup>d/</sup>
	Hungary <sup>g/</sup>	
	India <sup>b/c/</sup>	
Iran <sup>a/</sup>		
Italy <sup>a/</sup>		
	Japan <sup>b/c/</sup>	
	Morocco <sup>g/</sup>	
	Nigeria <sup>g/</sup>	Netherlands <sup>e/</sup>
	Pakistan <sup>g/</sup>	
		Poland <sup>d/</sup>
Portugal <sup>f/</sup>		
Singapore <sup>a/</sup>		
	South Africa <sup>b/c/</sup>	
	Spain <sup>g/</sup>	
Sweden <sup>f/</sup>		
		Syrian Arab Republic <sup>e/</sup>
		Thailand <sup>e/</sup>
	Union of Soviet Socialist Republics <sup>b/c/</sup>	
	United Kingdom of Great Britain and Northern Ireland <sup>b/c/</sup>	
	United States of America <sup>b/c/</sup>	
	Uruguay <sup>g/</sup>	
Venezuela <sup>a/</sup>		
	Viet-Nam <sup>g/</sup>	

<sup>a/</sup> Elected by the General Conference on 30 September 1968 under Article VI. A. 3 of the Statute.

<sup>b/</sup> Designated by the Board on 9 June 1970 under Article VI. A. 1 of the Statute.

<sup>c/</sup> Designated by the Board on 11 June 1969 under Article VI. A. 1 of the Statute.

<sup>d/</sup> Designated by the Board on 9 June 1970 under Article VI. A. 2 of the Statute.

<sup>e/</sup> Elected by the General Conference on 28 September 1970 under Article VI. A. 3 of the Statute.

<sup>f/</sup> Designated by the Board on 11 June 1969 under Article VI. A. 2 of the Statute.

<sup>g/</sup> Elected by the General Conference on 29 September 1969 under Article VI. A. 3 of the Statute.

## ANNEX B

DEVELOPMENTS IN THE IMPLEMENTATION OF THE RESULTS OF THE CONFERENCE  
OF NON-NUCLEAR-WEAPON STATESComments by IBRD, FAO and UNDP

1. The Secretary-General of the United Nations formally transmitted to the Agency the text of General Assembly Resolution 2664 (XXV) dealing with various aspects of the implementation of the results of the Conference of Non-Nuclear-Weapon States. In so doing, the Secretary-General stated that in view of the past interest of IBRD, FAO and UNDP in this matter, he was also sending them a copy of the Resolution.
2. In paragraph 5 of the Resolution the General Assembly invited the Director General, in consultation with the specialized agencies and other bodies concerned, to submit information on further developments concerning the question of the implementation of the results of the Conference. The Director General accordingly made appropriate inquiries of IBRD, FAO, and UNDP.
3. In its reply IBRD, citing paragraph 3 of the Resolution whereby the international sources of finances were recommended to "keep under review their policies regarding the financing of meritorious nuclear projects, bearing in mind not only the short-range but also the long-range contribution such projects may make to economic and technical development", referred to a communication of 18 February 1970 which set forth what IBRD was doing [1]. It had little to add to that earlier communication; it stated, however, that it "is continuing to follow closely the rapid evolution of both the technology and costs of nuclear facilities and routinely examines the merits of nuclear versus other generating plant whenever such comparisons are called for in our evaluation of the system development plans or specific projects proposals of Bank member countries".
4. FAO replied to the Director General's inquiry by intimating that the information relating to the joint FAO/IAEA programme of atomic energy in food and agriculture contained in paragraphs 30-42 of the covering report appeared to meet the situation adequately.
5. UNDP referred to the number of projects under its Special Fund component for which the Agency had been designated the executing agency. By June 1971 the Governing Council had earmarked funds in the amount of \$6.76 million for nine projects including the following three new projects [2]:
  - (a) Assistance to Argentina in establishing a national centre for non-destructive testing and quality control, as part of the Technology Branch of the National Atomic Energy Commission in Buenos Aires. The Agency will carry out this project in association with UNIDO;
  - (b) Assistance to India in establishing a cobalt-60 irradiation facility near the Bhabha Atomic Research Centre at Bombay for sterilizing medical products; and
  - (c) Assistance to the Chilean Atomic Energy Commission in establishing near Santiago a national institution for the application of nuclear research in agriculture, industry and medicine.

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[1] Reproduced in United Nations document A/8079, para. 10.

[2] See Table 5 in the covering report.

## A N N E X C

## IRRADIATED FOOD PRODUCTS CLEARED FOR HUMAN CONSUMPTION IN DIFFERENT COUNTRIES

Country	Product	Purpose of irradiation	Date of approval
Canada	potatoes	sprout inhibition	9 November 1960 14 June 1963
	onions	sprout inhibition	25 March 1965
	wheat and wheat products	insect disinfestation	28 February 1969
Denmark	potatoes	sprout inhibition	27 January 1970
Hungary	potatoes (experimental batches)	sprout inhibition	23 December 1969
Israel	potatoes	sprout inhibition	5 July 1967
	onions	sprout inhibition	25 July 1968
Netherlands	asparagus (experimental batches)	pasteurization by radiation	7 May 1969
	cacaobean (experimental batches)	disinfestation	7 May 1969
	strawberries (experimental batches)	pasteurization by radiation	7 May 1969
	mushrooms	pasteurization by radiation	23 October 1969
	potatoes	sprout inhibition	23 March 1970
	shrimps (experimental batches)	pasteurization by radiation	13 November 1970
	spices (experimental batches)	radicidation	1970
	onions (experimental batches)	sprout inhibition	5 February 1971
Spain	potatoes	sprout inhibition	4 November 1969
Union of Soviet Socialist Republics	potatoes	sprout inhibition	14 March 1958
	grain	insect disinfestation	1959
	dried fruits	insect disinfestation	15 February 1966
	dry food concentrates	insect disinfestation	6 June 1966
	fresh fruits and vegetables (experimental batches)	pasteurization by radiation (extension of market life)	July 1964
	semi-prepared raw beef, pork and rabbit products, in plastic bags (experimental batches)	pasteurization by radiation	11 July 1964
	poultry eviscerated, in plastic bags (experimental batches)	pasteurization by radiation	4 July 1966
	culinary prepared meat products (fried meat, entrecote), in plastic bags (experimental batches)	pasteurization by radiation	1 February 1967
	onions (experimental batches)	sprout inhibition	25 February 1967
	United States of America	wheat and wheat products	insect disinfestation
white potatoes		sprout inhibition	30 June 1964 2 October 1964 1 November 1965

## ANNEX D

## FELLOWSHIPS OFFERED OR PROVIDED FREE OF CHARGE IN 1970

Donor	Number of fellowships	
	Available	Awarded <sup>a/</sup>
<u>Member States</u>		
Argentina	5	2
Austria	3 <sup>b/</sup>	2
Belgium	6	5
Brazil	10	2
China	2	-
Czechoslovak Socialist Republic	9	2
Denmark	5	6
France	10	9
Germany, Federal Republic of	- <sup>c/</sup>	22
Hungary	4	-
India	10	4
Israel	5 <sup>d/</sup>	-
Italy	20 <sup>e/</sup>	12
Japan	16 <sup>f/</sup>	9
Mexico	2	-
Netherlands	8	7
Poland	10	4
Romania	12 <sup>g/</sup>	1
Spain	5	6
Sweden	6 <sup>h/</sup>	12
Switzerland	2	-
Tunisia	2	-
Union of Soviet Socialist Republics	- <sup>i/</sup>	5
United States of America	50	48
Yugoslavia	5 <sup>j/</sup>	3
Sub-total	207	161
<u>Regional organizations</u>		
Joint Institute for Nuclear Research at Dubna, Soviet Union	3	3
Total	210	164

a/ Number of awards less rejections and withdrawals.

b/ On the basis of nine man-months per fellowship, or a total of 27 man-months of training.

c/ No maximum number of openings was specified in the Government's offer.

d/ On the basis of nine man-months per fellowship, or a total of 45 man-months of training.

e/ On the basis of eight man-months per fellowship, or a total of 160 man-months of training.

f/ Six of these were carried over from 1969.

g/ Carried over from the offer made in 1965.

h/ On the basis of 12 man-months per fellowship.

i/ The available resources consisted of savings from prior years and the funds remaining from the Government's 1967 offer, which was for a specified amount of money rather than a given number of openings or man-months of training.

j/ On the basis of six man-months per fellowship, or a total of 30 man-months of training.

## ANNEX E

## RESEARCH CONTRACTS

I. Total value of contracts in 1970

Year	New contracts	Renewals	Total	Value
1970	70	143	213	780 684

II. Analysis by subject matter of contracts awarded or renewed in 1970

Subject matter of research	Number of contracts placed	Number of contracts renewed	Agency contribution in dollars
Nuclear technology			
Nuclear power and reactors	6	9	67 150
Waste treatment	1	6	33 600
Physics and chemistry	7	10	53 169
Radioisotope and radiation applications in			
Agriculture	11	53	208 300
Food technology	6	7	52 500
Industry	3	2	21 100
Medicine	10	26	139 725
Water resources development	4	7	57 700
Protection of man against ionizing radiations			
Health physics and radiation protection	8	6	53 940
Radiation biology	13	14	74 000
Environmental contamination and waste disposal	1	1	14 000
Dosimetry	-	2	5 500
Total	70	143	780 684

III. Analysis by country of contracts awarded or renewed in 1970

Country	Number of contracts placed	Number of contracts renewed	Agency contribution in dollars
Argentina	1	3	16 020
Austria	2	1	8 000
Belgium	1	4	17 000
Brazil	-	4	15 360
Bulgaria	3	3	28 100
Burma	-	1	2 500
Ceylon	-	2	6 850
Chile	1	2	12 500
China	1	7	30 950
Cuba	-	1	4 200
Colombia	1	1	6 500
Czechoslovak Socialist Republic	5	1	18 100
Denmark	1	-	3 000
Ecuador	-	1	4 000
Finland	-	2	10 000
Germany, Federal Republic of	1	-	5 000
Ghana	-	1	2 500
Greece	4	4	25 800
Hungary	2	7	31 370
India	7	6	39 464
Indonesia	1	1	6 500
Iran	1	-	4 400
Iraq	1	-	4 000
Israel	-	2	10 000
Italy	1	1	5 900
Japan	-	2	4 500
Kenya	1	2	12 400
Korea, Republic of	1	6	23 780
Lebanon	-	2	8 200
Madagascar	-	1	2 500
Mexico	2	3	19 550
Morocco	-	1	2 220
Netherlands	1	2	11 000
Nigeria	3	5	30 115
Pakistan	3	9	33 480
Peru	1	1	8 300
Philippines	2	5	21 000
Poland	2	1	15 500
Portugal	-	1	6 000
Romania	3	6	33 530
Senegal	-	1	7 000
South Africa	1	3	15 700
Spain	-	6	29 100
Sudan	2	-	8 500
Sweden	2	1	11 500

Country	Number of contracts placed	Number of contracts renewed	Agency contribution in dollars
Switzerland	1	-	3 000
Thailand	1	7	32 225
Turkey	3	2	18 000
Uganda	-	1	4 500
Union of Soviet Socialist Republics	-	3	7 420
United Arab Republic	-	4	24 000
United Kingdom of Great Britain and Northern Ireland	3	1	16 150
United States of America	-	1	3 000
Uruguay	1	2	9 500
Venezuela	1	-	3 000
Viet-Nam	-	3	10 200
Yugoslavia	2	6	27 800
Total	70	143	780 684

## ANNEX F

CONFERENCES, SYMPOSIA AND SEMINARS HELD DURING THE PERIOD  
1 JULY 1970-30 JUNE 1971

Date and place	Title	Co-sponsoring organizations	Number of participants	Number of countries represented	Number of organizations represented	Number of papers presented
<u>1970</u>						
6-10 July Karlsruhe	Symposium on Progress in Safeguards Techniques		227	32	6	66
10-14 August New York	Symposium on Environmental Aspects of Nuclear Power Stations	USAEC	357	25	10	58
17-21 August São Paulo	Symposium on Recovery of Uranium from its Ores and Other Sources		61	20	3	35
31 August-4 September Rotterdam	Symposium on Dynamic Studies with Radioisotopes in Clinical Medicine and Research		315	39	4	71
31 August-18 September Vienna	First Headquarters Seminar on Input Preparation for INIS		28	16	3	-
7-11 September Aix-en-Provence	Symposium on Developments in the Management of Low and Intermediate Level Radioactive Wastes	ENEA	180	29	6	52
14-18 September Athens	Symposium on Sterility Principle for Insect Control or Eradication	FAO	89	39	6	51
5-9 October Vienna	Symposium on Economic Integration of Nuclear Power Stations in Electric Power Systems	ECE	192	42	12	48
12-16 October Oslo	Symposium on Small and Medium Power Reactors		112	36	6	31
26-30 October Salzburg	Symposium on Use of Nuclear Techniques in the Measurement and Control of Environmental Pollution		177	33	9	54
23-27 November Vienna	Symposium on New Developments in Physical and Biological Radiation Detectors		156	29	5	61
23 November-11 December Bombay	First Regional Seminar for Asia and the Far East on Input Preparation for INIS		33	8	1	-
<u>1971</u>						
8-12 February Vienna	Seminar on Test Requirements for Packaging for the Transport of Radioactive Materials		92	25	5	41
8-12 March Lucas Heights	Symposium on Biophysical Aspects of Radiation Quality		68	16	4	39
29 March-2 April Vienna	Symposium on Use of Radiation and Radioisotopes for Genetic Improvement of Industrial Micro-organisms		88	28	5	30
17-23 June Wisconsin	Fourth Conference on Plasma Physics and Controlled Nuclear Fusion Research		511	24	2	147



## ANNEX G

## STATUS OF FINANCIAL CONTRIBUTIONS TO THE AGENCY ON 30 JUNE 1971

1. Advances to the Working Capital Fund and contributions to the Regular Budget for 1971  
(in United States dollars)

Member State	Working Capital Fund			Regular Budget for 1971			
	Assessed	Paid	Outstanding	Assessed	Credits	Paid	Outstanding
Afghanistan	800	800	-	5 221	-	-	5 221
Albania	800	800	-	5 221	159	-	5 062
Algeria	1 800	1 800	-	11 747	358	11 389	-
Argentina	16 800	16 800	-	109 637	3 301	-	106 336
Australia	27 600	27 600	-	180 117	5 647	87 235	87 235
Austria	10 400	10 400	-	67 870	1 909	65 961	-
Belgium	20 000	20 000	-	130 520	4 096	126 424	-
Bolivia	800	800	-	5 221	-	-	5 221
Brazil	16 200	16 200	-	105 721	-	-	105 721
Bulgaria	3 200	3 200	-	20 883	-	189	20 694
Burma	1 000	1 000	-	6 526	199	-	6 327
Byelorussian Soviet Socialist Republic	9 200	9 200	-	60 039	1 869	-	58 170
Cameroon	800	800	-	5 221	159	5 062	-
Canada	54 600	54 600	-	356 320	11 534	344 786	-
Ceylon	1 000	1 000	-	6 526	278	-	6 248
Chile	4 200	4 200	-	27 409	-	-	27 409
China	72 400	72 400	-	472 482	-	-	472 482
Colombia	3 600	3 600	-	23 493	835	-	22 658
Congo, Democratic Republic of the	1 000	1 000	-	6 526	459	-	6 067
Costa Rica	800	800	-	5 221	-	-	5 221
Cuba	3 400	3 400	-	22 188	-	-	22 188
Cyprus	800	800	-	5 221	159	5 062	-
Czechoslovak Socialist Republic	16 600	16 600	-	108 332	-	-	108 332
Denmark	11 200	11 200	-	73 091	2 227	70 864	-
Dominican Republic	800	800	-	5 221	-	-	5 221
Ecuador	800	800	-	5 221	-	-	5 221
El Salvador	800	800	-	5 221	-	-	5 221
Ethiopia	800	800	-	5 221	-	-	5 221
Finland	8 800	8 800	-	57 429	1 551	55 878	-
France	108 600	108 600	-	708 724	21 994	686 730	-
Gabon	800	800	-	5 221	159	-	5 062
Germany, Federal Republic of	127 000	127 000	-	828 802	26 726	401 038	401 038
Ghana	1 400	1 400	-	9 136	278	8 858	-
Greece	5 200	5 200	-	33 935	875	33 060	-
Guatemala	1 000	1 000	-	6 526	-	-	6 526
Haiti	800	800	-	5 221	-	-	5 221
Holy See	800	800	-	5 221	159	5 062	-
Hungary	9 400	9 400	-	61 344	-	-	61 344
Iceland	800	800	-	5 221	159	5 062	-
India	31 400	31 400	-	204 916	6 842	198 074	-
Indonesia	6 200	6 200	-	40 461	1 061	-	39 400
Iran	4 000	4 000	-	26 104	716	-	25 388
Iraq	1 200	1 200	-	7 831	278	7 553	-
Ireland	3 000	3 000	-	19 578	-	19 578	-
Israel	3 600	3 600	-	23 493	597	22 896	-
Italy	58 600	58 600	-	382 424	9 307	373 117	-
Ivory Coast	800	800	-	5 221	159	5 062	-
Jamaica	1 000	1 000	-	6 526	199	6 327	-
Japan	68 400	68 400	-	446 378	10 103	436 275	-
Jordan	800	800	-	5 221	293	-	4 928
Kenya	800	800	-	5 221	159	5 062	-
Khmer Republic	800	800	-	5 221	-	-	5 221
Korea, Republic of	2 200	2 200	-	14 357	477	-	13 880
Kuwait	1 200	1 200	-	7 831	199	7 632	-
Lebanon	1 000	1 000	-	6 526	199	-	6 327

Member State	Working Capital Fund			Regular Budget for 1971			
	Assessed	Paid	Outstanding	Assessed	Credits	Paid	Outstanding
Liberia	800	800	-	5 221	-	-	5 221
Libyan Arab Republic	800	800	-	5 221	-	830	4 391
Liechtenstein	800	800	-	5 221	159	5 062	-
Luxembourg	1 000	1 000	-	6 526	199	6 327	-
Madagascar	800	800	-	5 221	159	-	5 062
Malaysia	2 000	2 000	-	13 052	-	-	13 052
Mali	800	800	-	5 221	-	-	5 221
Mexico	15 800	15 800	-	103 110	2 903	100 207	-
Monaco	800	800	-	5 221	159	5 062	-
Morocco	1 800	1 800	-	11 747	398	11 349	-
Netherlands	21 000	21 000	-	137 046	3 977	53 069	80 000
New Zealand	6 600	6 600	-	43 071	1 352	-	41 719
Niger	800	800	-	5 221	-	5 221	-
Nigeria	2 600	2 600	-	16 967	-	-	16 967
Norway	7 800	7 800	-	50 903	1 591	49 312	-
Pakistan	6 600	6 600	-	43 071	1 312	21 535	20 224
Panama	800	800	-	5 221	-	-	5 221
Paraguay	800	-	800	5 221	-	-	5 221
Peru	1 800	1 800	-	11 747	-	-	11 747
Philippines	6 200	6 200	-	40 461	1 233	-	39 228
Poland	26 600	26 600	-	173 592	-	86 796	86 796
Portugal	2 800	2 800	-	18 273	517	17 756	-
Romania	6 600	6 600	-	43 071	1 233	21 331	20 507
Saudi Arabia	1 000	1 000	-	6 526	239	-	6 287
Senegal	800	800	-	5 221	217	-	5 004
Sierra Leone	800	800	-	5 221	159	1 348	3 714
Singapore	1 000	1 000	-	6 526	159	6 367	-
South Africa	9 400	9 400	-	61 344	1 869	59 475	-
Spain	16 600	16 600	-	108 332	2 425	105 907	-
Sudan	1 000	1 000	-	6 526	-	-	6 526
Sweden	22 600	22 600	-	147 488	4 494	142 994	-
Switzerland	15 600	15 600	-	101 806	3 142	98 664	-
Syrian Arab Republic	800	800	-	5 221	199	-	5 022
Thailand	2 400	2 400	-	15 662	517	15 145	-
Tunisia	800	800	-	5 221	29	5 192	-
Turkey	6 400	6 400	-	41 766	1 233	-	40 533
Uganda	800	800	-	5 221	-	-	5 221
Ukrainian Soviet Socialist Republic	35 000	35 000	-	228 410	7 039	-	221 371
Union of Soviet Socialist Republics	264 600	264 600	-	1 726 780	53 811	-	1 672 969
United Arab Republic	3 600	3 600	-	23 493	-	-	23 493
United Kingdom of Great Britain and Northern Ireland	119 800	119 800	-	781 815	26 010	-	755 805
United States of America	629 000	629 000	-	4 104 854	-	-	4 104 854
Uruguay	1 600	1 600	-	10 442	-	-	10 442
Venezuela	8 200	8 200	-	53 513	-	-	53 513
Viet-Nam	1 200	1 200	-	7 831	278	7 553	-
Yugoslavia	7 200	7 200	-	46 987	1 273	22 857	22 857
Zambia	300	800	-	5 221	-	-	5 221
<b>TOTAL</b>	<b>1 999 200<sup>a/</sup></b>	<b>1 998 400</b>	<b>800</b>	<b>13 046 779<sup>a/</sup></b>	<b>233 964</b>	<b>3 843 595</b>	<b>8 969 220</b>

<sup>a/</sup> The withdrawal of Nicaragua from membership on 14 December 1970, after the General Conference had approved the scale of assessment for 1971, reduces the Working Capital Fund of \$2 million by \$800 and the total 1971 Regular Budget assessments of \$13 052 000 by \$5221.

## 2. Outstanding contributions to the Regular Budgets for the years 1958-1970

(In United States dollars)

Member State	1958-61	1962	1963	1964	1965	1966a/	1967	1968	1969	1970	Total
Afghanistan	-	-	-	3 343	3 857	4 333	4 587	5 082	4 155	4 741	30 098
Bolivia	-	-	-	-	-	-	1 802	4 040	4 355	4 741	14 938
Brazil	-	-	-	-	-	-	-	-	-	91 016	91 016
Chile	-	-	-	-	-	-	-	-	-	20 321	20 321
China	-	-	-	-	-	-	-	-	370 454	430 264	800 718
Costa Rica	-	-	-	-	-	-	-	-	-	3 543	3 543
Cuba	-	-	-	-	-	-	-	13 936	18 309	20 150	52 395
Dominican Republic	-	3 015	3 561	3 610	3 857	3 467	3 670	4 065	4 355	4 741	34 341
Ecuador	-	-	-	-	-	-	-	2 452	4 155	4 741	11 348
El Salvador	-	-	-	-	-	21	-	4 040	4 283	4 741	13 085
Ethiopia	-	-	-	-	-	-	-	-	4 017	4 741	8 758
Guatemala	-	-	-	-	-	-	779	4 065	5 444	5 926	16 214
Haiti	6 825 <sup>b/</sup>	2 652	2 849	2 888	3 085	3 467	3 670	4 065	4 355	4 741	38 597
Honduras <sup>c/</sup>	-	-	-	2 020	3 085	3 467	3 670	-	-	-	12 242
Hungary	-	-	-	-	-	-	-	-	-	52 330	52 330
Khmer Republic	-	-	-	-	-	-	-	-	3 348	4 741	8 089
Liberia	-	-	-	-	-	-	-	4 040	4 283	4 741	13 085
Mali	-	-	-	-	-	21	2 322	4 065	4 355	4 741	15 483
Nicaragua <sup>d/</sup>	-	-	-	-	-	-	-	-	2 849	4 741	7 590
Nigeria	-	-	-	-	-	-	-	-	-	12 532	12 532
Panama	-	-	-	-	-	-	-	-	-	7	7
Paraguay	8 530 <sup>e/</sup>	2 652	2 849	2 888	3 085	3 467	3 670	4 065	4 355	4 741	40 302
Peru	-	-	-	-	-	-	-	3 930	9 799	10 667	24 396
Sudan	-	-	-	-	-	-	-	-	5 062	5 926	10 988
Uganda	-	-	-	-	-	-	-	-	-	4 507	4 507
United Arab Republic	-	-	-	-	-	-	-	-	-	20 106	20 106
United States of America	-	-	-	-	-	-	-	-	-	13 844	13 844
Venezuela	-	-	-	-	-	-	-	-	-	45 963	45 963
Uruguay	-	-	-	-	-	-	-	-	7 822	9 482	17 304
Zambia	-	-	-	-	-	-	-	-	3 717	4 741	8 458
Total outstanding	15 355	8 319	9 259	14 749	16 969	18 243	24 170	57 845	469 472	808 217	1 442 598
Total paid	21 406 075	6 631 760	7 146 004	7 215 525	7 715 313	8 659 316	9 160 840	10 113 785	10 441 981	11 062 563	99 553 162
Total assessments	21 421 430	6 640 079	7 155 263	7 230 274	7 732 282	8 677 559	9 185 010	10 171 630	10 911 453	11 870 780	100 985 760
Percentage of assessments paid	99.92	99.87	99.87	99.80	99.78	99.79	99.74	99.43	95.69	93.19	98.57

a/ Includes supplementary assessment.

b/ Payable to the Regular Budgets as follows: \$2021 for 1959; \$2337 for 1960; and \$2467 for 1961.

c/ Withdrew from membership on 19 June 1967.

d/ Withdrew from membership on 14 December 1970.

e/ Payable to the Regular Budgets as follows: \$1636 for 1958; \$2090 for 1959; \$2337 for 1960 and \$2467 for 1961.

## 3. Voluntary contributions to the General Fund for 1970 and 1971

(Expressed in United States dollars at the rate of exchange used for the United Nations Development Programme)

Member State	1970			1971		
	Pledged	Paid	Outstanding	Pledged	Paid	Outstanding
Afghanistan	-	-	-	-	-	-
Albania	800	800	-	800 <sup>b/</sup>	-	800
Algeria	-	-	-	-	-	-
Argentina	16 800	10 248	6 552	21 000	-	21 000
Australia	28 400	28 400	-	30 000	30 000	-
Austria	10 400	10 400	-	13 000	13 000	-
Belgium	12 500 <sup>a/</sup>	12 500	-	12 500 <sup>b/</sup>	-	12 500
Bolivia	-	-	-	-	-	-
Brazil	18 000	-	18 000	30 000	-	30 000
Bulgaria	3 200	3 200	-	4 000	-	4 000
Burma	1 000	1 000	-	1 000 <sup>b/</sup>	-	1 000
Byelorussian Soviet Socialist Republic	-	-	-	-	-	-
Cameroon	1 000	1 000	-	1 000	-	1 000
Canada	57 000	57 000	-	70 000	-	70 000
Ceylon	-	-	-	-	-	-
Chile	-	-	-	1 000 <sup>b/</sup>	-	1 000
China	10 000 <sup>a/</sup>	10 000	-	10 000 <sup>b/</sup>	-	10 000
Colombia	2 000 <sup>a/</sup>	2 000	-	2 500 <sup>b/</sup>	2 500	-
Congo, Democratic Republic of the	1 000	-	1 000	1 500	-	1 500
Costa Rica	800	-	800	-	-	-
Cuba	-	-	-	-	-	-
Cyprus	900	900	-	900 <sup>b/</sup>	900	-
Czechoslovak Socialist Republic	20 833	20 833	-	20 833	20 833	-
Denmark	11 200	11 200	-	14 000	14 000	-
Dominican Republic	-	-	-	-	-	-
Ecuador	-	-	-	-	-	-
El Salvador	-	-	-	-	-	-
Ethiopia	800	-	800	-	-	-
Finland	8 800	8 800	-	11 000	11 000	-
France	30 405 <sup>a/</sup>	30 405	-	30 571 <sup>b/</sup>	30 571	-
Gabon	-	-	-	-	-	-
Germany, Federal Republic of	127 200	127 200	-	158 750	79 375	79 375
Ghana	2 000	2 000	-	2 000	2 000	-
Greece	7 763	7 763	-	7 800	7 800	-
Guatemala	500 <sup>a/</sup>	500	-	-	-	-
Haiti	800	-	800	-	-	-
Holy See	2 000	2 000	-	2 000	2 000	-
Hungary	9 500	9 500	-	11 800	-	11 800
Iceland	800	800	-	1 000	1 000	-
India	35 000	35 000	-	40 000	40 000	-
Indonesia	6 200	5 800	400	7 750	-	7 750
Iran	3 600 <sup>a/</sup>	3 600	-	4 600 <sup>b/</sup>	-	4 600
Iraq	1 200	1 200	-	1 500	1 500	-
Ireland	3 000	3 000	-	3 750	3 750	-
Israel	3 600	3 600	-	3 600 <sup>b/</sup>	3 600	-
Italy	45 800 <sup>a/</sup>	45 800	-	73 250 <sup>b/</sup>	73 250	-
Ivory Coast	800	800	-	800	800	-
Jamaica	-	-	-	-	-	-
Japan	68 600	68 600	-	85 500	85 500	-
Jordan	800	800	-	-	-	-
Kenya	-	-	-	-	-	-
Khmer Republic	800	800	-	-	-	-
Korea, Republic of	2 200	2 200	-	2 750	-	2 750
Kuwait	-	-	-	1 500	1 500	-
Lebanon	1 000	1 000	-	1 250	-	1 250
Liberia	-	-	-	-	-	-
Libyan Arab Republic	-	-	-	-	-	-
Liechtenstein	1 000	1 000	-	1 000	1 000	-
Luxembourg	-	-	-	-	-	-
Madagascar	800	800	-	1 000	1 000	-

Member State	1970			1971		
	Pledged	Paid	Outstanding	Pledged	Paid	Outstanding
Malaysia	-	-	-	-	-	-
Mali	-	-	-	-	-	-
Mexico	14 700 <sup>a/</sup>	14 700	-	3 943 <sup>b/</sup>	3 943	-
Monaco	2 000	2 000	-	2 000	2 000	-
Morocco	2 000	2 000	-	2 050 <sup>b/</sup>	2 050	-
Netherlands	21 000	21 000	-	40 000	-	40 000
New Zealand	6 600	6 600	-	-	-	-
Nicaragua	-	-	-	-	-	-
Niger	800	-	800	-	-	-
Nigeria	-	-	-	3 080 <sup>b/</sup>	-	3 080
Norway	7 800	7 800	-	9 750	9 750	-
Pakistan	6 600	6 600	-	8 250	8 250	-
Panama	-	-	-	1 000	-	1 000
Paraguay	-	-	-	-	-	-
Peru	1 800	1 800	-	2 250	1 500	750
Philippines	6 200	6 200	-	7 750 <sup>b/</sup>	7 750	-
Poland	10 417 <sup>a/</sup>	10 417	-	10 417 <sup>b/</sup>	10 417	-
Portugal	3 600	3 600	-	3 600	3 580	20
Romania	8 250	8 250	-	8 250	-	8 250
Saudi Arabia	2 000	2 000	-	2 000	-	2 000
Senegal	-	-	-	-	-	-
Sierra Leone	-	-	-	-	-	-
Singapore	1 000	1 000	-	1 000 <sup>b/</sup>	1 000	-
South Africa	9 400	9 400	-	11 750	-	11 750
Spain	16 600	16 600	-	20 750	-	20 750
Sudan	-	-	-	-	-	-
Sweden	22 600	22 600	-	28 250	28 250	-
Switzerland	15 600	15 600	-	19 500	19 500	-
Syrian Arab Republic	800	800	-	-	-	-
Thailand	4 000	4 000	-	4 000	4 000	-
Tunisia	1 000	-	1 000	-	-	-
Turkey	6 400	6 400	-	8 000	8 000	-
Uganda	1 000	-	1 000	-	-	-
Ukrainian Soviet Socialist Republic	-	-	-	-	-	-
Union of Soviet Socialist Republics	166 667 <sup>a/</sup>	166 667	-	277 778 <sup>b/</sup>	277 778	-
United Arab Republic	11 500	-	11 500	11 500	-	11 500
United Kingdom of Great Britain and Northern Ireland	120 998	120 998	-	150 948	150 948	-
United States of America	630 000 <sup>cd/</sup>	580 000	50 000	786 250 <sup>cd/</sup>	-	786 250
Uruguay	1 600	-	1 600	2 000	-	2 000
Venezuela	-	-	-	-	-	-
Viet-Nam	1 200	1 200	-	1 200 <sup>b/</sup>	515	685
Yugoslavia	8 000	8 000	-	9 000	-	9 000
Zambia	-	-	-	-	-	-
<b>TOTAL</b>	<b>1 672 933</b>	<b>1 578 681</b>	<b>94 252</b>	<b>2 123 470</b>	<b>966 110</b>	<b>1 157 360</b>

<sup>a/</sup> Pledge is less than the Member's Regular Budget assessment ratio (GC(XIII)/RES/257) applied to the target of \$2 million for voluntary contributions set by Resolution GC(XIII)/RES/254, para. 1.

<sup>b/</sup> Pledge is less than the Member's Regular Budget assessment ratio (GC(XIV)/RES/267) applied to the target of \$2.5 million for voluntary contributions set by Resolution GC(XIV)/RES/265, para. 1.

<sup>c/</sup> When making this pledge, the United States also pledged itself to make contributions in kind in the form of cost-free experts, equipment for technical assistance, laboratory equipment, special nuclear materials and Type II fellowships, to a total value of approximately \$750 000 for the year 1970 and \$760 000 for the year 1971. It is to be noted that other Members as well contribute to the Agency's resources in this way, and information relating to all such contributions made in 1970 is provided in the Agency's accounts for last year (GC(XV)/459, Schedule G).

<sup>d/</sup> The United States pledged an amount equal to 40% of all contributions for 1970 and 1971 that are paid by the end of 1971 and 1972 respectively, up to a percentage of the target equal to its percentage assessments under the Regular Budgets for 1970 and 1971 respectively.

