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

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**NOTE**

All sums of money are expressed in United States dollars.
INTRODUCTION

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]


[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.

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
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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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.

[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

<table>
<thead>
<tr>
<th></th>
<th>1969 (in thousands of dollars)</th>
<th>1970 (in thousands of dollars)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regular programme</td>
<td></td>
<td></td>
</tr>
<tr>
<td>UNDP(TA)</td>
<td>1586</td>
<td>1749</td>
</tr>
<tr>
<td>UNDP(SF)</td>
<td>748</td>
<td>1134</td>
</tr>
<tr>
<td>Assistance in kind (estimated value)</td>
<td>792</td>
<td>666</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Year</th>
<th>Value of requests received (in thousands of dollars)</th>
<th>Value of assistance approved (in thousands of dollars)</th>
<th>Percentage of requests met</th>
</tr>
</thead>
<tbody>
<tr>
<td>1966</td>
<td>3,000</td>
<td>901.6</td>
<td>30.0</td>
</tr>
<tr>
<td>1967</td>
<td>2,600</td>
<td>975.0</td>
<td>37.5</td>
</tr>
<tr>
<td>1968</td>
<td>3,600</td>
<td>977.0</td>
<td>27.1</td>
</tr>
<tr>
<td>1969</td>
<td>3,700</td>
<td>977.0</td>
<td>26.4</td>
</tr>
<tr>
<td>1970</td>
<td>3,400</td>
<td>1,250.0</td>
<td>36.8</td>
</tr>
<tr>
<td>1971</td>
<td>3,600</td>
<td>1,891.0</td>
<td>52.5</td>
</tr>
</tbody>
</table>
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

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Type I</td>
<td>82</td>
<td>113</td>
<td>121</td>
<td>118</td>
<td>159</td>
<td>118</td>
</tr>
<tr>
<td>Type II</td>
<td>137</td>
<td>138</td>
<td>148</td>
<td>146</td>
<td>164</td>
<td>181</td>
</tr>
<tr>
<td>UNDP(TA)</td>
<td>64</td>
<td>18</td>
<td>46</td>
<td>30</td>
<td>34</td>
<td>24</td>
</tr>
<tr>
<td>TOTAL</td>
<td>283</td>
<td>269</td>
<td>315</td>
<td>294</td>
<td>357</td>
<td>323</td>
</tr>
</tbody>
</table>

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>
<thead>
<tr>
<th>Project</th>
<th>Place and dates</th>
<th>Total number of participants</th>
<th>Source of funds</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interregional training course on nuclear techniques in the mining industry</td>
<td>Cracow, Poland 8 June to 4 July 1970</td>
<td>19</td>
<td>UNDP(TA)</td>
</tr>
<tr>
<td>Interregional training course on the use of isotopes and radiation in animal science</td>
<td>Ithaca, United States 20 July to 4 September 1970</td>
<td>18</td>
<td>Regular programme</td>
</tr>
<tr>
<td>FAO/IAEA group fellowship study tour on the use of isotopes and radiation in agricultural research</td>
<td>The Soviet Union 4 August to 3 September 1970</td>
<td>14</td>
<td>FAO</td>
</tr>
<tr>
<td>Study tour (seminar) on the industrial application of radioisotopes and radiation</td>
<td>Canada and the United States - 8 August to 19 September 1970</td>
<td>18</td>
<td>Regular programme</td>
</tr>
<tr>
<td>Interregional training course on the use of isotopes and radiation in soil plant nutrition studies</td>
<td>Wageningen, Netherlands 10 August to 25 September 1970</td>
<td>19</td>
<td>Regular programme</td>
</tr>
<tr>
<td>International advanced summer school on reactor physics</td>
<td>Herceg-Novi, Yugoslavia 31 August to 10 September 1970</td>
<td>90</td>
<td>UNDP(TA)</td>
</tr>
<tr>
<td>Interregional training course on uranium ore analysis</td>
<td>Madrid 7 September to 27 November 1970</td>
<td>22</td>
<td>UNDP(TA)</td>
</tr>
<tr>
<td>Regional training course on industrial radiation processing</td>
<td>Tokyo and Takasaki, Japan - 5 October to 13 November 1970</td>
<td>17</td>
<td>UNDP(TA)</td>
</tr>
<tr>
<td>Regional training course on radiation dosimetry</td>
<td>San Juan, Puerto Rico 5 October to 27 November 1970</td>
<td>9</td>
<td>UNDP(TA)</td>
</tr>
<tr>
<td>Advanced regional training course on plans and procedures for radiation emergencies</td>
<td>Buenos Aires 9 to 20 November 1970</td>
<td>24</td>
<td>UNDP(TA)</td>
</tr>
<tr>
<td>Interregional training course on nuclear law</td>
<td>Athens 7 to 18 December 1970</td>
<td>18</td>
<td>Regular programme</td>
</tr>
<tr>
<td>Project</td>
<td>Place and dates</td>
<td>Total number of participants</td>
<td>Source of funds</td>
</tr>
<tr>
<td>------------------------------------------------------------------------</td>
<td>------------------------------------------------------</td>
<td>-----------------------------</td>
<td>-----------------</td>
</tr>
<tr>
<td>Regional training course on general isotope techniques</td>
<td>Cairo, Middle Eastern Regional Radioisotope Centre for the Arab Countries - 12 April to 1 May 1971</td>
<td>11</td>
<td>UNDP(TA)</td>
</tr>
<tr>
<td>International training course on radioimmunoassay techniques</td>
<td>Pisa, Italy 3 to 14 May 1971</td>
<td>40</td>
<td>Regular programme</td>
</tr>
<tr>
<td>Regional training course on the application of isotope techniques in hydrology</td>
<td>Bangkok 3 May to 11 June 1971</td>
<td>15</td>
<td>UNDP(TA)</td>
</tr>
<tr>
<td>Study tour on standardization of radiation dosimetry</td>
<td>Czechoslovak Socialist Republic, France, the Soviet Union and the United Kingdom 6 May to 25 June 1971</td>
<td>29</td>
<td>Regular programme</td>
</tr>
<tr>
<td>Regional training course on radioisotope laboratory techniques</td>
<td>Kwabenya, Ghana 10 May to 27 August 1971</td>
<td>20</td>
<td>UNDP(TA)</td>
</tr>
<tr>
<td>International training course on the use of radiation and other mutagen treatments for crop improvement</td>
<td>Lund and Svalöf, Sweden and Risø, Denmark 2 June to 10 July 1971</td>
<td>15</td>
<td>SIDA</td>
</tr>
<tr>
<td>International training course on the use of radioisotopes and radiation in animal science and veterinary medicine</td>
<td>Fort Collins, Colorado, United States 7 June to 16 July 1971</td>
<td>18</td>
<td>Regular programme</td>
</tr>
<tr>
<td>International training course on the use of radioisotopes and radiation in entomology</td>
<td>Gainesville, Florida, United States 21 June to 13 August 1971</td>
<td>20</td>
<td>Regular programme</td>
</tr>
<tr>
<td>Training and demonstration programme on advanced atomic energy technology</td>
<td>Asia and the Far East 1970/71</td>
<td>19</td>
<td>UNDP(TA)</td>
</tr>
<tr>
<td>Training and demonstration programme on advanced atomic energy technology</td>
<td>Europe and the Middle East 1970/71</td>
<td>24</td>
<td>UNDP(TA)</td>
</tr>
<tr>
<td>Research and demonstration project on isotopes in animal parasitology</td>
<td>Kabete, Kenya 1970/71</td>
<td>4</td>
<td>UNDP(TA)</td>
</tr>
</tbody>
</table>
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

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

\(^a/\) To be implemented in association with the United Nations.

\(^b/\) To be implemented in association with UNIDO.
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

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

<table>
<thead>
<tr>
<th>Research programme</th>
<th>Countries in which co-ordinated research programmes are being carried out</th>
<th>Agency contribution in dollars 1970/71</th>
</tr>
</thead>
<tbody>
<tr>
<td>8. Neutron seed irradiation</td>
<td>Bulgaria, China, Federal Republic of Germany&lt;sup&gt;2&lt;/sup&gt;, Italy&lt;sup&gt;2&lt;/sup&gt;, Puerto Rico&lt;sup&gt;2&lt;/sup&gt;, United States (3&lt;sup&gt;2&lt;/sup&gt;), Venezuela</td>
<td>2 500</td>
</tr>
<tr>
<td>9. Plant protein improvement</td>
<td>China, India, Japan, Republic of Korea, Pakistan, Philippines, Thailand</td>
<td>21 000</td>
</tr>
<tr>
<td>10. Trace element metabolism and disease in livestock</td>
<td>Argentina, Austria&lt;sup&gt;2&lt;/sup&gt;, Cuba, Denmark&lt;sup&gt;2&lt;/sup&gt;, Federal Republic of Germany (2&lt;sup&gt;2&lt;/sup&gt;), Netherlands&lt;sup&gt;2&lt;/sup&gt;, United Kingdom (2&lt;sup&gt;2&lt;/sup&gt;), United States (3&lt;sup&gt;2&lt;/sup&gt;), Yugoslavia&lt;sup&gt;2&lt;/sup&gt;</td>
<td>7 350</td>
</tr>
<tr>
<td>11. Parasitic diseases in domestic animals</td>
<td>Denmark&lt;sup&gt;2&lt;/sup&gt;, Kenya (2), Israel&lt;sup&gt;2&lt;/sup&gt;, Italy&lt;sup&gt;2&lt;/sup&gt;, United Kingdom&lt;sup&gt;2&lt;/sup&gt;, United States&lt;sup&gt;2&lt;/sup&gt;, Yugoslavia&lt;sup&gt;2&lt;/sup&gt;</td>
<td>9 000</td>
</tr>
<tr>
<td>12. Fruit fly eradication or control by the sterile-male technique</td>
<td>Federal Republic of Germany&lt;sup&gt;2&lt;/sup&gt;, Mexico, Netherlands (2), Portugal, Spain, Switzerland&lt;sup&gt;2&lt;/sup&gt;</td>
<td>17 000</td>
</tr>
<tr>
<td>13. Control of animal insect pests by the sterile-male technique</td>
<td>Belgium&lt;sup&gt;2&lt;/sup&gt;, El Salvador, Federal Republic of Germany&lt;sup&gt;2&lt;/sup&gt;, Kenya, Portugal, United Kingdom&lt;sup&gt;2&lt;/sup&gt;</td>
<td>14 900</td>
</tr>
<tr>
<td>14. Rice insect control and eradication</td>
<td>China (3), Republic of Korea, Pakistan (2), Thailand (2)</td>
<td>31 160</td>
</tr>
<tr>
<td>15. Ecology and behaviour of the Heliothis complex as related to the sterile-male technique</td>
<td>Argentina, Colombia, El Salvador, Mexico, United States (4&lt;sup&gt;2&lt;/sup&gt;), Venezuela</td>
<td>15 020</td>
</tr>
<tr>
<td>16. Control of insect populations by the sterile-male technique</td>
<td>Austria&lt;sup&gt;2&lt;/sup&gt;, United States&lt;sup&gt;2&lt;/sup&gt;, Yugoslavia</td>
<td>3 000</td>
</tr>
<tr>
<td>17. Fate and significance of pesticide residues in food and environment</td>
<td>Bulgaria, Finland, Federal Republic of Germany (2&lt;sup&gt;2&lt;/sup&gt;), Ghana, Hungary&lt;sup&gt;2&lt;/sup&gt;, Israel (2&lt;sup&gt;2&lt;/sup&gt;), Japan&lt;sup&gt;2&lt;/sup&gt;, Netherlands&lt;sup&gt;2&lt;/sup&gt;, Pakistan, Uganda, United Kingdom (2&lt;sup&gt;2&lt;/sup&gt;), United States&lt;sup&gt;2&lt;/sup&gt;, Yugoslavia</td>
<td>24 000</td>
</tr>
<tr>
<td>18. Microbiological aspects of food preservation by irradiation</td>
<td>Japan&lt;sup&gt;2&lt;/sup&gt;, United States&lt;sup&gt;2&lt;/sup&gt;</td>
<td>-</td>
</tr>
<tr>
<td>Research programme</td>
<td>Countries in which co-ordinated research programmes are being carried out</td>
<td>Agency contribution in dollars 1970/71</td>
</tr>
<tr>
<td>---------------------</td>
<td>--------------------------------------------------------------------------</td>
<td>---------------------------------------</td>
</tr>
<tr>
<td>19. Shelf-life extension of irradiated fruits</td>
<td>Federal Republic of Germany, Hungary, India, Iraq, Italy, Mexico, Philippines</td>
<td>21 500</td>
</tr>
<tr>
<td>20. Preservation of fishery products by irradiation</td>
<td>Belgium, Federal Republic of Germany, Republic of Korea, Philippines, Spain, Thailand</td>
<td>33 000</td>
</tr>
<tr>
<td>21. General food irradiation</td>
<td>Netherlands, Pakistan</td>
<td>6 000</td>
</tr>
</tbody>
</table>

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. See Table 4 above. 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 reproducible 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 radio-isotopes 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 disinfestation 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.
RADIATION BIOLOGY

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

Table 7
Research contracts on radiation biology

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

\(^a/\) 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

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

a/ 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);

(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,

---

### Table 9

Research contracts on dosimetry

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

\(^a\)/ Cost-free research agreement.

\(^b\)/ 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

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

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.

[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

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

\(^a/\) 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.
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

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

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 (Melekess, 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\(_3\)O\(_8\) reserves at a price below ten dollars

<table>
<thead>
<tr>
<th>Country</th>
<th>1967</th>
<th>1970</th>
</tr>
</thead>
<tbody>
<tr>
<td>Canada</td>
<td>200 000</td>
<td>232 000</td>
</tr>
<tr>
<td>France</td>
<td>45 000</td>
<td>45 000</td>
</tr>
<tr>
<td>South Africa</td>
<td>205 000</td>
<td>200 000</td>
</tr>
<tr>
<td>United States</td>
<td>180 000</td>
<td>250 000</td>
</tr>
<tr>
<td>Others</td>
<td>70 000</td>
<td>113 000</td>
</tr>
<tr>
<td>Totals</td>
<td>700 000</td>
<td>840 000</td>
</tr>
</tbody>
</table>

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>
<thead>
<tr>
<th>Receiving State/Organization</th>
<th>Purpose</th>
<th>Quantity and type of fissile material</th>
<th>Approximate enrichment (when applicable)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Algeria</td>
<td>Standard reference material in mineral form</td>
<td>0.3–0.5% uranium(^{a/})</td>
<td></td>
</tr>
<tr>
<td>Argentina</td>
<td>Nuclear fuel tests</td>
<td>200 kg oxide uranium</td>
<td>1.162%</td>
</tr>
<tr>
<td>Brazil</td>
<td>Production of radioisotopes and separation of fission products with a long half-life</td>
<td>465 g (23{5})(^{\text{a/}}) (\text{Pu})</td>
<td>93%</td>
</tr>
<tr>
<td>Burma</td>
<td>Neutron source</td>
<td>16 g (\text{Pu})^{a/}</td>
<td></td>
</tr>
<tr>
<td>Burma</td>
<td>Irradiation targets</td>
<td>5 mCi (23{8})(\text{Pu}), (1 \text{ mg}) (23{9})(\text{Pu}), (5 \text{ mg}) (23{3})(\text{U}), (50 \text{ mg}) (23{5})(\text{U})^{a/}</td>
<td></td>
</tr>
<tr>
<td>Ceylon</td>
<td>Neutron source</td>
<td>80 g (\text{Pu})^{a/}</td>
<td></td>
</tr>
<tr>
<td>China</td>
<td>Research</td>
<td>(23{5})(\text{U}), (23{9})(\text{Pu}), (23{7})(\text{Np}) contained in 5 samples(^{a/})</td>
<td></td>
</tr>
<tr>
<td>Congo, Democratic Republic of the</td>
<td>Fission counter</td>
<td>1.20 g (23{5})(\text{U})^{a/}</td>
<td>93%</td>
</tr>
<tr>
<td>Congo, Democratic Republic of the</td>
<td>Fuel for a research reactor</td>
<td>3 kg (23{5})(\text{U})</td>
<td>20%</td>
</tr>
<tr>
<td>Finland</td>
<td>Fission counter</td>
<td>1.68 g (23{5})(\text{U})^{a/}</td>
<td></td>
</tr>
<tr>
<td>Greece</td>
<td>Fuel for a research reactor</td>
<td>6340 g (23{5})(\text{U})</td>
<td>90%</td>
</tr>
<tr>
<td>Hungary</td>
<td>Research</td>
<td>(\text{Pu foil})^{a/}</td>
<td></td>
</tr>
<tr>
<td>IAEA</td>
<td>Research</td>
<td>(23{5})(\text{U}) contained in 8 samples(^{a/})</td>
<td></td>
</tr>
<tr>
<td>India</td>
<td>Standard reference material</td>
<td>3 g uranium oxide, (0.25 \text{ g plutonium sulphate})^{a/}</td>
<td></td>
</tr>
<tr>
<td>India</td>
<td>Standard reference material</td>
<td>0.5 g plutonium metal(^{a/})</td>
<td></td>
</tr>
<tr>
<td>India</td>
<td>Research</td>
<td>100 mg (24{2})(\text{Pu})</td>
<td></td>
</tr>
<tr>
<td>Receiving State/ Organization</td>
<td>Purpose</td>
<td>Quantity and type of fissile material</td>
<td>Approximate enrichment (when applicable)</td>
</tr>
<tr>
<td>-------------------------------</td>
<td>--------------------------------------------------</td>
<td>---------------------------------------</td>
<td>------------------------------------------</td>
</tr>
<tr>
<td>India</td>
<td>Research</td>
<td>100 mg PuO$_2$ containing $^{242}$Pu$^{a/}$</td>
<td></td>
</tr>
<tr>
<td>Indonesia</td>
<td>Neutron source</td>
<td>80 g Pu$^{a/}$</td>
<td></td>
</tr>
<tr>
<td>Iraq</td>
<td>Neutron source</td>
<td>16 g Pu$^{a/}$</td>
<td></td>
</tr>
<tr>
<td>Mexico</td>
<td>Fuel for a training reactor</td>
<td>3750 g $^{235}$U</td>
<td>20%</td>
</tr>
<tr>
<td>Pakistan</td>
<td>Irradiation targets</td>
<td>5 g $^{239}$Pu, 300 mg $^{240}$Pu, 9 g $^{235}$U, $^{252}$Cf$^{a/}$</td>
<td></td>
</tr>
<tr>
<td>Pakistan</td>
<td>Fuel for a power reactor</td>
<td>1.7 kg $^{235}$U</td>
<td>10.49%</td>
</tr>
<tr>
<td>Pakistan</td>
<td>Replacement booster rods for power reactor</td>
<td>10 kg $^{235}$U</td>
<td>10.5%</td>
</tr>
<tr>
<td>Poland</td>
<td>Research</td>
<td>$^{235}$U, $^{237}$Np contained in 5 fission foils$^{a/}$</td>
<td></td>
</tr>
<tr>
<td>Romania</td>
<td>Research</td>
<td>$^{235}$U, $^{239}$Pu contained in 2 fission foils$^{a/}$</td>
<td></td>
</tr>
<tr>
<td>Singapore</td>
<td>For use in a radioisotopes in industry technical assistance programme as neutron source</td>
<td>16 g Pu$^{a/}$</td>
<td></td>
</tr>
<tr>
<td>United Arab Republic</td>
<td>Neutron source</td>
<td>80 g Pu$^{a/}$</td>
<td></td>
</tr>
<tr>
<td>United Arab Republic</td>
<td>Research</td>
<td>500 µg Pu$^{a/}$</td>
<td></td>
</tr>
<tr>
<td>United Arab Republic</td>
<td>Neutron source</td>
<td>16 g Pu$^{a/}$</td>
<td></td>
</tr>
<tr>
<td>Yugoslavia</td>
<td>Fuel for a research reactor</td>
<td>4750 g $^{235}$U</td>
<td>20%</td>
</tr>
<tr>
<td>Yugoslavia</td>
<td>For testing of fuel element</td>
<td>440 g $^{235}$U$^{a/}$</td>
<td></td>
</tr>
<tr>
<td>Yugoslavia</td>
<td>Research</td>
<td>600 mg $^{235}$U$^{a/}$</td>
<td></td>
</tr>
</tbody>
</table>

$^{a/}$ 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

<table>
<thead>
<tr>
<th>Receiving State</th>
<th>Value in dollars</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brazil</td>
<td>5 192</td>
</tr>
<tr>
<td>Chile</td>
<td>24 022</td>
</tr>
<tr>
<td>Greece</td>
<td>1 038</td>
</tr>
<tr>
<td>Indonesia</td>
<td>14 162</td>
</tr>
<tr>
<td>Yugoslavia</td>
<td>5 586</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>50 000</strong></td>
</tr>
</tbody>
</table>

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
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.

[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>
<thead>
<tr>
<th>Research programme</th>
<th>Countries in which research is conducted with Agency support</th>
<th>Agency contribution in dollars 1970/71</th>
</tr>
</thead>
<tbody>
<tr>
<td>General matters of radiation protection</td>
<td>Austria, Brazil, Bulgaria, Czechoslovak Socialist Republic, Greece, Israel, Pakistan, Poland, United Kingdom, Yugoslavia</td>
<td>28 100</td>
</tr>
<tr>
<td>Co-ordinated research in accident dosimetry</td>
<td>Canadaa/, Czechoslovak Socialist Republica/, Francea/, Federal Republic of Germanya/, Hungarya/, Indiana/, Poland, United Kingdoma/, Soviet Uniona/, United Statesa/, Yugoslaviab/</td>
<td>5 000</td>
</tr>
<tr>
<td>Co-ordinated research on estimation of plutonium by</td>
<td>United Arab Republic, Soviet Uniona/</td>
<td>7 000</td>
</tr>
<tr>
<td>external counting</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Research programme</td>
<td>Countries in which research is conducted with Agency support</td>
<td>Agency contribution in dollars 1970/71</td>
</tr>
<tr>
<td>--------------------------------------------------------</td>
<td>--------------------------------------------------------------------------------------------------------------------------</td>
<td>---------------------------------------</td>
</tr>
<tr>
<td>Measurement techniques</td>
<td>Belgium, Bulgaria, Czechoslovak Socialist Republic^a/; France, India, Republic of Korea, Romania</td>
<td>27 740</td>
</tr>
<tr>
<td>Transport packagings</td>
<td>Sweden^a/</td>
<td>-</td>
</tr>
<tr>
<td>Low- and medium-level radioactive waste management</td>
<td>Bulgaria, China, Federal Republic of Germany^a/; Hungary, India, Republic of Korea, Pakistan, Philippines, Romania, Soviet Union</td>
<td>39 100</td>
</tr>
<tr>
<td>Research in marine radioactivity</td>
<td>Argentina^a/; Belgium, Finland^a/; India^a/; Israel, Italy (^a/); Japan^a/; Netherlands^a/; New Zealand, Norway, Romania (^a/); Spain, Turkey, United Kingdom^b/; United States^b/; Yugoslavia^a/</td>
<td>44 180</td>
</tr>
</tbody>
</table>

\^a/ Cost-free research agreement.
\^b/ 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);
Revising the Health Physics Addendum to the Agency's Code of Practice on the Safe Handling of Radioisotopes (Vienna, February 1971); and

Preparing a manual on neutron monitoring (Vienna, June 1971);

An advanced regional course on plans and procedures for radiation emergencies (Buenos Aires, November 1970) for specialists in countries in Latin America; and

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
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.
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

<table>
<thead>
<tr>
<th>Item</th>
<th>1969-70</th>
<th>1970-71</th>
</tr>
</thead>
<tbody>
<tr>
<td>Meetings</td>
<td>13</td>
<td>16</td>
</tr>
<tr>
<td>Participants</td>
<td>2225</td>
<td>2686</td>
</tr>
<tr>
<td>Countries taking part</td>
<td>67</td>
<td>65</td>
</tr>
<tr>
<td>Papers presented</td>
<td>710</td>
<td>784</td>
</tr>
</tbody>
</table>

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

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

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

<table>
<thead>
<tr>
<th>Holdings</th>
<th>June 1970</th>
<th>June 1971</th>
</tr>
</thead>
<tbody>
<tr>
<td>Books and bound periodicals</td>
<td>32 616</td>
<td>34 845</td>
</tr>
<tr>
<td>Technical reports (microfiche,</td>
<td>123 692</td>
<td>141 088</td>
</tr>
<tr>
<td>hard copy)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Periodical subscriptions</td>
<td>1 297</td>
<td>1 361</td>
</tr>
<tr>
<td>Films</td>
<td>468</td>
<td>483</td>
</tr>
</tbody>
</table>

**Table 20**
Library services

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Loans to Member States (Books</td>
<td>541</td>
<td>473</td>
</tr>
<tr>
<td>and periodicals)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Circulation within Secretariat</td>
<td>45 839</td>
<td>50 382</td>
</tr>
<tr>
<td>(Books, documents, periodicals,</td>
<td></td>
<td></td>
</tr>
<tr>
<td>microfiche and other loans)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pages of Xerox copies</td>
<td>71 960</td>
<td>84 169</td>
</tr>
<tr>
<td>Film loans to Member States</td>
<td>953</td>
<td>928</td>
</tr>
</tbody>
</table>
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 the 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

[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:

<table>
<thead>
<tr>
<th>Facility Type</th>
<th>30 June 1970</th>
<th>30 June 1971</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nuclear power stations</td>
<td>10</td>
<td>9[15]</td>
</tr>
<tr>
<td>Other reactors</td>
<td>68</td>
<td>66[15]</td>
</tr>
<tr>
<td>Conversion plants, fabrication plants and fuel reprocessing plants</td>
<td>4</td>
<td>10</td>
</tr>
<tr>
<td>Other separate accountability areas</td>
<td>74</td>
<td>85</td>
</tr>
</tbody>
</table>

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

[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.
(a) Special fissionable material

<table>
<thead>
<tr>
<th>Material</th>
<th>Total element</th>
<th>Fissionable isotope</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plutonium</td>
<td>770 kg</td>
<td></td>
</tr>
<tr>
<td>Enriched uranium of 20%</td>
<td>2 863 kg</td>
<td>372 kg</td>
</tr>
<tr>
<td>enrichment and above</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Enriched uranium below 20%</td>
<td>240 505 kg</td>
<td>5 216 kg</td>
</tr>
<tr>
<td>enrichment</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(b) Source material

<table>
<thead>
<tr>
<th>Material</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Natural uranium</td>
<td>909 312 kg</td>
</tr>
<tr>
<td>Depleted uranium</td>
<td>236 477 kg</td>
</tr>
<tr>
<td>Thorium</td>
<td>261 kg</td>
</tr>
</tbody>
</table>

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

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)

<table>
<thead>
<tr>
<th>State(s)</th>
<th>Subject</th>
<th>Entry into force</th>
<th>INFCIRC</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Project Agreements</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Argentina</td>
<td>Siemens SUR-100</td>
<td>13 Mar 1970</td>
<td>143</td>
</tr>
<tr>
<td></td>
<td>RAEP Reactor</td>
<td>1 Dec 1964</td>
<td>62</td>
</tr>
<tr>
<td>Chile</td>
<td>Herald Reactor</td>
<td>19 Dec 1969</td>
<td>137</td>
</tr>
<tr>
<td>Congo, Democratic Republic of the</td>
<td>TRICO Reactor</td>
<td>27 Jun 1962</td>
<td>37</td>
</tr>
<tr>
<td>Finland</td>
<td>FrR-1 Reactor</td>
<td>30 Dec 1960</td>
<td>24</td>
</tr>
<tr>
<td></td>
<td>FINN sub-critical assembly</td>
<td>30 Jul 1963</td>
<td>53</td>
</tr>
<tr>
<td>Indonesia</td>
<td>Additional core-load for Triga Reactor</td>
<td>10 May 1960</td>
<td>97</td>
</tr>
<tr>
<td>Iran</td>
<td>UTRR Reactor</td>
<td>23 Jun 1967</td>
<td>89</td>
</tr>
<tr>
<td>Japan</td>
<td>JRR-3</td>
<td>24 Mar 1939</td>
<td>3</td>
</tr>
<tr>
<td>Pakistan</td>
<td>PRR Reactor</td>
<td>5 Mar 1962</td>
<td>34</td>
</tr>
<tr>
<td></td>
<td>Booster rods for KANUPP</td>
<td>17 Jun 1968</td>
<td>116</td>
</tr>
<tr>
<td>Philippines</td>
<td>PRR-1 Reactor</td>
<td>26 Sep 1966</td>
<td>88</td>
</tr>
<tr>
<td>Spain</td>
<td>Coral I Reactor</td>
<td>23 Jun 1967</td>
<td>29</td>
</tr>
<tr>
<td>Uruguay</td>
<td>URR Reactor</td>
<td>24 Sep 1965</td>
<td>87</td>
</tr>
<tr>
<td>Viet-Nam</td>
<td>VNBR Reactor</td>
<td>10 Oct 1967</td>
<td>106</td>
</tr>
<tr>
<td>Yugoslavia</td>
<td>TRIGA II Reactor</td>
<td>4 Oct 1961</td>
<td>32</td>
</tr>
<tr>
<td><strong>Transfer Agreements</strong></td>
<td>(Bilateral co-operation agreements between the indicated States)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Argentina/USA</td>
<td></td>
<td>25 Jul 1969</td>
<td>130</td>
</tr>
<tr>
<td>Australia/USA</td>
<td></td>
<td>26 Sep 1966</td>
<td>91</td>
</tr>
<tr>
<td>Austria/USA</td>
<td></td>
<td>23 Jan 1967</td>
<td>62</td>
</tr>
<tr>
<td>Brazil/USA</td>
<td></td>
<td>31 Oct 1963</td>
<td>110</td>
</tr>
<tr>
<td>Canada/Japan</td>
<td></td>
<td>12 Nov 1969</td>
<td>85</td>
</tr>
<tr>
<td>Canada/India</td>
<td></td>
<td>29 Oct 1965</td>
<td>72</td>
</tr>
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**Unilateral submissions**

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<th>INFCIRC</th>
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**Agreements under NPT**

- Austria
- Finland

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

b/ 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 other than power reactors

<table>
<thead>
<tr>
<th>Member State</th>
<th>Name of reactor</th>
<th>Location</th>
<th>Type</th>
<th>Capacity MW(th)</th>
<th>In operation</th>
<th>Maximum routine inspections per year</th>
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<td>Argentina</td>
<td>RA-0/Argentine Reactor 0</td>
<td>Constituyentes</td>
<td>Tank</td>
<td>0.00</td>
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<td>x</td>
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<td>RA-2/Argentine Reactor 2</td>
<td>Constituyentes</td>
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<td>x</td>
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<td>Eseiza</td>
<td>Pool-tank</td>
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<td>Lucas Heights</td>
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<td>Lucas Heights</td>
<td>Argonaut</td>
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<td>Graz</td>
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<td>Hsin-chu</td>
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<td>Location</td>
<td>Type</td>
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<td>In operation</td>
<td>Maximum routine inspections per year</td>
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### B. Nuclear power stations

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<th>Member State</th>
<th>Name of power station</th>
<th>Location</th>
<th>Type</th>
<th>Capacity MW(e)</th>
<th>In operation</th>
<th>Maximum routine inspections per year</th>
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<tbody>
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<td>Tarapur Atomic Power Station</td>
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<td>Magnox</td>
<td>185</td>
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<td>Tsuruga</td>
<td>BWR</td>
<td>320</td>
<td>x</td>
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<td>Mihama-1 Nuclear Power Station</td>
<td>Mihama-</td>
<td>PWR</td>
<td>340</td>
<td>x</td>
<td>A</td>
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<td>Fukushima</td>
<td>BWR</td>
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<td>Karachi Nuclear Power Project</td>
<td>Karachi</td>
<td>Candu</td>
<td>137</td>
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<td>A</td>
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<td>José Cabrera Nuclear Power Station</td>
<td>Almonacid</td>
<td>PWR</td>
<td>156</td>
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<td>A</td>
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<td>Santander</td>
<td>BWR</td>
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<td>Bradwell Nuclear Power Station</td>
<td>Bradwell</td>
<td>Magnox</td>
<td>300</td>
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### 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, Sao Paulo, Brasil
- Fuel Fabrication Plant, Risé, 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 Vignon 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

<table>
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<th>Duration of contract</th>
<th>Title</th>
<th>Institute</th>
<th>Agency contribution in dollars</th>
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</thead>
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<td>1970-71</td>
<td>Integral experiments restricted at key points of control for highly enriched fuel element cycle from fabrication plant to dissolver of reprocessing plant</td>
<td>Centre d'études de l'énergie nucléaire Brussels</td>
<td>8 000</td>
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<tr>
<td>1971-72</td>
<td>Development of a method for continuous measurement of uranium inventory of process vessels</td>
<td>Eurochemic Mol, Belgium</td>
<td>3 000</td>
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<tr>
<td>1970-71</td>
<td>Verification of reprocessing input measurements</td>
<td>Eurochemic Mol, Belgium</td>
<td>4 000</td>
</tr>
<tr>
<td>1971</td>
<td>Determination of $^{235}$U enrichment in unirradiated uranium bearing streams</td>
<td>Institute of Physics Bulgarian Academy of Science Sofia</td>
<td>6 500</td>
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<tr>
<td>1971</td>
<td>Development and fabrication of probes and auxiliary equipment for measurement of plutonium using neutron coincidence counting techniques</td>
<td>Institute of Physics Bulgarian Academy of Science Sofia</td>
<td>4 200</td>
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<tr>
<td>1971</td>
<td>Safeguards study of the Canadian Westinghouse Fuel Fabrication Plant</td>
<td>Canadian Westinghouse Ltd. Hamilton, Ontario, Canada</td>
<td>17 000</td>
</tr>
<tr>
<td>1971-72</td>
<td>Safeguarding the input to a fuel reprocessing plant</td>
<td>Institut für Angewandte Reaktorphysik Kernforschungszentrum Karlsruhe, Federal Republic of Germany</td>
<td>8 000</td>
</tr>
<tr>
<td>1970-71</td>
<td>Study of non-destructive measurement method for highly enriched U-Al alloy plate fuel</td>
<td>Sumitomo Electric Industries, Ltd. Japan</td>
<td>-</td>
</tr>
<tr>
<td>1971-72</td>
<td>Evaluation of operational data on a Swedish low enrichment uranium fuel fabrication plant</td>
<td>ASEA-ATOM Fuel Fabrication Plant Västeras, Sweden</td>
<td>2 500</td>
</tr>
<tr>
<td>Duration of contract</td>
<td>Title</td>
<td>Institute</td>
<td>Agency contribution in dollars</td>
</tr>
<tr>
<td>----------------------</td>
<td>----------------------------------------------------------------------</td>
<td>------------------------------------------------------------------------------------------------------</td>
<td>-------------------------------</td>
</tr>
<tr>
<td>1969-70</td>
<td>Determination of the accumulation of transuranium elements in spent fuel from the First Atomic Power Station</td>
<td>Institute of Physics and Power Engineering Obninsk, Soviet Union</td>
<td>-</td>
</tr>
<tr>
<td>1969-71</td>
<td>Chromatographic separation of uranium and plutonium from reprocessing plant liquid waste followed by automatic measurement of plutonium amounts by probe type alpha detector and the uranium by photometry methods</td>
<td>Vernadsky Institute Moscow</td>
<td>25 000</td>
</tr>
<tr>
<td>1971</td>
<td>Measurement of neutron decay constants in a highly critical reactor as a safeguards method</td>
<td>Nuclear Energetics Minsk, and Institute of Physics Kiev, Soviet Union</td>
<td>-</td>
</tr>
<tr>
<td>1971-72</td>
<td>Integral safeguards experiment at the Novo- Voronezh LWR Power Reactor Plant</td>
<td>I, V, Kurchatov Institute of Atomic Energy and Novo-Voronezh Nuclear Power Station Soviet Union</td>
<td>40 000</td>
</tr>
<tr>
<td>1969</td>
<td>The examination of possible design criteria which will facilitate the application of safeguards</td>
<td>United Kingdom Atomic Energy Authority Risley, United Kingdom</td>
<td>5 000</td>
</tr>
<tr>
<td>1970-71</td>
<td>Nuclear material transfer monitor</td>
<td>United Kingdom Atomic Energy Authority Risley, United Kingdom</td>
<td>4 000</td>
</tr>
<tr>
<td>1971</td>
<td>Development of an application technique to verify the fissile material of irradiated fuel in a zero energy reactor</td>
<td>United Kingdom Atomic Energy Authority Reactor Group United Kingdom</td>
<td>5 000</td>
</tr>
<tr>
<td>1971</td>
<td>Development of a device and application technique designed to reveal tampering with reactor fuel elements</td>
<td>Battelle Northwest Battelle Memorial Institute Richland, Washington United States</td>
<td>25 000</td>
</tr>
<tr>
<td>1971</td>
<td>Development of an information system for nuclear materials assay technique</td>
<td>JRB Associates La Jolla, California United States</td>
<td>5 000</td>
</tr>
<tr>
<td>Duration of contract</td>
<td>Title</td>
<td>Institute</td>
<td>Agency contribution in dollars</td>
</tr>
<tr>
<td>----------------------</td>
<td>----------------------------------------------------------------------</td>
<td>----------------------------------</td>
<td>-------------------------------</td>
</tr>
<tr>
<td>1971</td>
<td>Feasibility study of safeguards methods and techniques applicable to</td>
<td>General Electric Co.</td>
<td>5 000</td>
</tr>
<tr>
<td></td>
<td>the Midwest Recovery Plant (MFRP)</td>
<td>United States</td>
<td></td>
</tr>
<tr>
<td>1971</td>
<td>Tamper-resistant instrumentation for a chemical reprocessing plant</td>
<td>Braddock, Dunn and McDonald, Inc.</td>
<td>20 000</td>
</tr>
<tr>
<td></td>
<td></td>
<td>United States</td>
<td></td>
</tr>
</tbody>
</table>
GROWTH OF AGENCY SAFEGUARDS

LEGEND

- Number of States with safeguards agreements
- Number of nuclear power stations under safeguards
- MW(e) of nuclear power stations under safeguards
- Number of reactors other than power reactors under safeguards
- Budgeted cost of safeguards

^ all data relate to safeguards agreements approved by the Board up to 30 June of the indicated year
^ Data relate to reactors under construction or operational

[Graph showing the growth of agency safeguards with data points for years 1962 to 1971, including states, power stations, other reactors, MW(e), and budgeted cost.]
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. 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.

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.


[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.


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:

<table>
<thead>
<tr>
<th>Description</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Budgetary savings</td>
<td>$18,893</td>
</tr>
<tr>
<td>Contributions assessed on new Member States</td>
<td>$17,780</td>
</tr>
<tr>
<td>Excess of miscellaneous income over budget:</td>
<td></td>
</tr>
<tr>
<td>Actual miscellaneous income</td>
<td>$436,694</td>
</tr>
<tr>
<td>Less: budget</td>
<td>$397,000</td>
</tr>
<tr>
<td>Excess of miscellaneous income over budget:</td>
<td>$39,694</td>
</tr>
<tr>
<td>Budgetary surplus for 1970</td>
<td>$76,367</td>
</tr>
</tbody>
</table>

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:

<table>
<thead>
<tr>
<th>Description</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Advances to the Working Capital Fund</td>
<td>$1,998,400</td>
</tr>
<tr>
<td>Contributions to the Regular Budget for 1971</td>
<td>$4,077,559</td>
</tr>
</tbody>
</table>

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 $1,672,833 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\(^{a/}\)

<table>
<thead>
<tr>
<th>Administrative Fund</th>
<th>$</th>
<th>$</th>
<th>$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assessed contributions to the Regular Budget</td>
<td>11 853 000</td>
<td>11 870 780</td>
<td></td>
</tr>
<tr>
<td>Member States included in the scale for 1970</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>New Members</td>
<td>17 780</td>
<td>11 870 780</td>
<td></td>
</tr>
<tr>
<td>Actual miscellaneous income</td>
<td>436 694</td>
<td>Sub-total</td>
<td>12 307 474</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>General Fund (including Operating Fund I and II)</th>
<th>$</th>
<th>$</th>
<th>$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voluntary contributions pledged for 1970</td>
<td>1 672 133</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Miscellaneous income (from investments, Laboratory, local costs, etc.)</td>
<td>547 898</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Special voluntary contributions pledged</td>
<td>289 640</td>
<td>Sub-total</td>
<td>2 509 671</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>United Nations Development Programme</th>
<th>$</th>
<th>$</th>
<th>$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technical Assistance Account(^{b/})</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Funds allocated in 1970 and miscellaneous income</td>
<td>1 679 963</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Special Fund(^{c/})</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Funds allocated in 1970 and miscellaneous income</td>
<td>205 529</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Executing Agency Overhead Costs</td>
<td>30 200</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Special Accounts</th>
<th>$</th>
<th>$</th>
<th>$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Swedish International Development Authority Trust Fund</td>
<td>85 668</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Central Funds in Trust Technical Assistance Programme to the Democratic Republic of the Congo</td>
<td>158</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Financial contributions received towards the costs of conferences, symposia and seminars for 1970</th>
<th>$</th>
<th>$</th>
<th>$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amounts pledged</td>
<td>72 898</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Contributions in services and in kind(^{d/})</th>
<th>$</th>
<th>$</th>
<th>$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type II fellowships awarded(^{e/})</td>
<td>617 800</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Technical assistance equipment and supplies</td>
<td>231 180</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Laboratory equipment and supplies</td>
<td>102 919</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Library, etc.</td>
<td>3 683</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Special nuclear materials</td>
<td>50 000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sub-total</td>
<td>1 005 582</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TOTAL</td>
<td>17 897 543</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\(^{a/}\) See the Agency's accounts for 1970 (GC(XV)/459).
\(^{b/}\) Ibid., Statement IV.
\(^{c/}\) Ibid., Statement V and VI.
\(^{d/}\) 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 - 2 533 man/days in 1970.
\(^{e/}\) 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

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Argentina&lt;sup&gt;a/b/&lt;/sup&gt;</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Australia&lt;sup&gt;b/c/&lt;/sup&gt;</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Brazil&lt;sup&gt;c/e/&lt;/sup&gt;</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Canada&lt;sup&gt;b/c/&lt;/sup&gt;</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Czechoslovak Socialist Republic&lt;sup&gt;c/&lt;/sup&gt;</td>
<td></td>
<td></td>
</tr>
<tr>
<td>France&lt;sup&gt;b/c/&lt;/sup&gt;</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hungary&lt;sup&gt;e/&lt;/sup&gt;</td>
<td></td>
<td></td>
</tr>
<tr>
<td>India&lt;sup&gt;b/c/&lt;/sup&gt;</td>
<td></td>
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<tr>
<td>Iran&lt;sup&gt;c/&lt;/sup&gt;</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Italy&lt;sup&gt;c/&lt;/sup&gt;</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Japan&lt;sup&gt;b/c/&lt;/sup&gt;</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Morocco&lt;sup&gt;e/&lt;/sup&gt;</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nigeria&lt;sup&gt;e/&lt;/sup&gt;</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pakistan&lt;sup&gt;e/&lt;/sup&gt;</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Portugal&lt;sup&gt;c/&lt;/sup&gt;</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Singapore&lt;sup&gt;e/&lt;/sup&gt;</td>
<td></td>
<td></td>
</tr>
<tr>
<td>South Africa&lt;sup&gt;b/c/&lt;/sup&gt;</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spain&lt;sup&gt;e/&lt;/sup&gt;</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sweden&lt;sup&gt;c/&lt;/sup&gt;</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Syria&lt;sup&gt;e/&lt;/sup&gt;</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Syrian Arab Republic&lt;sup&gt;e/&lt;/sup&gt;</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thailand&lt;sup&gt;e/&lt;/sup&gt;</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Union of Soviet Socialist Republics&lt;sup&gt;b/e/&lt;/sup&gt;</td>
<td></td>
<td></td>
</tr>
<tr>
<td>United Kingdom of Great Britain and Northern Ireland&lt;sup&gt;b/e/&lt;/sup&gt;</td>
<td></td>
<td></td>
</tr>
<tr>
<td>United States of America&lt;sup&gt;b/e/&lt;/sup&gt;</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Uruguay&lt;sup&gt;e/&lt;/sup&gt;</td>
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<td></td>
</tr>
<tr>
<td>Venezuela&lt;sup&gt;c/&lt;/sup&gt;</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Viet-Nam&lt;sup&gt;c/&lt;/sup&gt;</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<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.
DEVELOPMENTS IN THE IMPLEMENTATION OF THE RESULTS OF THE CONFERENCE OF NON-NUCLEAR-WEAPON STATES

Comments 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.

---

[2] See Table 5 in the covering report.
### ANNEX C

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

<table>
<thead>
<tr>
<th>Country</th>
<th>Product</th>
<th>Purpose of irradiation</th>
<th>Date of approval</th>
</tr>
</thead>
<tbody>
<tr>
<td>Canada</td>
<td>potatoes</td>
<td>sprout inhibition</td>
<td>9 November 1960</td>
</tr>
<tr>
<td></td>
<td>onions</td>
<td>sprout inhibition</td>
<td>14 June 1963</td>
</tr>
<tr>
<td></td>
<td>wheat and wheat products</td>
<td>insect disinfestation</td>
<td>25 March 1965</td>
</tr>
<tr>
<td>Denmark</td>
<td>potatoes</td>
<td>sprout inhibition</td>
<td>27 January 1970</td>
</tr>
<tr>
<td>Hungary</td>
<td>potatoes (experimental batches)</td>
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<td>23 December 1969</td>
</tr>
<tr>
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<td>sprout inhibition</td>
<td>5 July 1967</td>
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<td>onions</td>
<td>sprout inhibition</td>
<td>25 July 1968</td>
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<tr>
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<td>asparagus (experimental batches)</td>
<td>pasteurization by radiation</td>
<td>7 May 1969</td>
</tr>
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<td>cacaobeans (experimental batches)</td>
<td>pasteurization by radiation</td>
<td>7 May 1969</td>
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<td>strawberries (experimental batches)</td>
<td>pasteurization by radiation</td>
<td>7 May 1969</td>
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<td></td>
<td>mushrooms</td>
<td>pasteurization by radiation</td>
<td>23 October 1969</td>
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<td>sprout inhibition</td>
<td>23 March 1970</td>
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<td>sprout inhibition</td>
<td>4 November 1969</td>
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<td>fresh fruits and vegetables (experimental batches)</td>
<td>pasteurization by radiation (extension of market life)</td>
<td>11 July 1964</td>
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<td>semi-prepared raw beef, pork and rabbit products, in plastic bags (experimental batches)</td>
<td>pasteurization by radiation</td>
<td></td>
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<td></td>
<td>poultry eviscerated, in plastic bags (experimental batches)</td>
<td>pasteurization by radiation</td>
<td>4 July 1966</td>
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<td>culinary prepared meat products (fried meat, entrecote), in plastic bags (experimental batches)</td>
<td>pasteurization by radiation</td>
<td>1 February 1967</td>
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<td></td>
<td>onions (experimental batches)</td>
<td>sprout inhibition</td>
<td>25 February 1967</td>
</tr>
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<td>insect disinfestation</td>
<td>21 August 1963</td>
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<td>white potatoes</td>
<td>sprout inhibition</td>
<td>2 October 1964</td>
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<td>28 February 1966</td>
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<td>1 November 1965</td>
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# ANNEX D

## FELLOWSHIPS OFFERED OR PROVIDED FREE OF CHARGE IN 1970

<table>
<thead>
<tr>
<th>Donor</th>
<th>Number of fellowships</th>
<th>Available</th>
<th>Awarded(^a/)</th>
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<td>Brazil</td>
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<td>China</td>
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<td>Czechoslovak Socialist Republic</td>
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<td></td>
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<tr>
<td>France</td>
<td>10</td>
<td>9</td>
<td></td>
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<tr>
<td>Germany, Federal Republic of Hungary</td>
<td>-2(^c/)</td>
<td>22</td>
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<td>India</td>
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<td>4</td>
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<td>Israel</td>
<td>5(^d/)</td>
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</tr>
<tr>
<td>Italy</td>
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<td></td>
</tr>
<tr>
<td>Japan</td>
<td>16(^f/)</td>
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<td>7</td>
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<td>Poland</td>
<td>10</td>
<td>4</td>
<td></td>
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<td>Romania</td>
<td>12(^g/)</td>
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<td></td>
</tr>
<tr>
<td>Spain</td>
<td>5</td>
<td>6</td>
<td></td>
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<tr>
<td>Sweden</td>
<td>6(^h/)</td>
<td>12</td>
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</tr>
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<td></td>
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<tr>
<td>Tunisia</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Union of Soviet Socialist Republic</td>
<td>-1(^i/)</td>
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<td>United States of America</td>
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<tr>
<td>Yugoslavia</td>
<td>5(^j/)</td>
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<tr>
<td><strong>Sub-total</strong></td>
<td><strong>207</strong></td>
<td><strong>161</strong></td>
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<tr>
<td><strong>Regional organizations</strong></td>
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<td>Joint Institute for Nuclear Research at Dubna, Soviet Union</td>
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<td>3</td>
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<tr>
<td><strong>Total</strong></td>
<td><strong>210</strong></td>
<td><strong>164</strong></td>
<td></td>
</tr>
</tbody>
</table>

---

\(^a/\) 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

<table>
<thead>
<tr>
<th>Year</th>
<th>New contracts</th>
<th>Renewals</th>
<th>Total</th>
<th>Value</th>
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<tr>
<td>1970</td>
<td>70</td>
<td>143</td>
<td>213</td>
<td>780 684</td>
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</tbody>
</table>

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

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

Total 70 143 780 684
### III. Analysis by country of contracts awarded or renewed in 1970

<table>
<thead>
<tr>
<th>Country</th>
<th>Number of contracts placed</th>
<th>Number of contracts renewed</th>
<th>Agency contribution in dollars</th>
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<tr>
<td>Belgium</td>
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<td>15 360</td>
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<td>28 100</td>
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<td>Burma</td>
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<td><strong>Total</strong></td>
<td><strong>70</strong></td>
<td><strong>143</strong></td>
<td><strong>780 684</strong></td>
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## ANNEX F

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

<table>
<thead>
<tr>
<th>Date and place</th>
<th>Title</th>
<th>Co-sponsoring organizations</th>
<th>Number of participants</th>
<th>Number of countries represented</th>
<th>Number of organizations represented</th>
<th>Number of papers presented</th>
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<td>6-10 July</td>
<td>Karlsruhe</td>
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<td>New York</td>
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<td>17-21 August</td>
<td>São Paulo</td>
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<td>4 September Rotterdam</td>
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<td>16 September Vienna</td>
<td>First Headquarters Seminar on Input Preparation for INIS</td>
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<td>Aix-en-Provence</td>
<td>Symposium on Developments in the Management of Low and Intermediate Level Radioactive Wastes</td>
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<td>Symposium on Economic Integration of Nuclear Power Stations in Electric Power Systems</td>
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- 72 -
**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)

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$\textsuperscript{a/}$ 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 $5 million by $800 and the total 1971 Regular Budget assessments of $13 053 000 by $5221.
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**Total outstanding**: 15 355 8 319 9 259 14 749 16 069 18 243 24 170 57 845 469 472 808 217 1 442 598

**Total paid**: 21 406 075 6 653 760 7 146 004 7 215 525 7 715 313 8 659 316 9 160 840 10 133 785 10 441 981 11 062 563 99 553 162

**Total assessments**: 21 421 430 6 640 079 7 155 263 7 230 274 7 722 282 8 677 559 9 185 010 10 171 630 10 911 453 11 870 780 100 895 760

**Percentage of assessments paid**: 99.92 99.87 99.87 99.80 99.78 99.79 99.74 99.43 95.68 93.19 98.57

---

*Includes supplementary assessment.

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

*Withdrawn from membership on 19 June 1967.

*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)

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**TOTAL:** 1,672,933 1,578,681 94,252 2,123,470 966,110 1,157,360

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**a/** 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.

**b/** 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.

**c/** 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).

**d/** 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.