REPORT ON THE ACTIVITIES

OF THE

DANISH ATOMIC ENERGY COMMISSION

UP TO 31 MARCH 1957

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JANUARY 1958

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ANNEXES

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INTRODUCTION

Section 4 of Act No. 312 of 21 December 1955 on an Atomic Energy Commission stipulates that the Commission shall report annually on its activities to the Minister of Finance who will transmit the report to Parliament.

The first report of the Danish Atomic Energy Commission, which was presented in October 1957, covers the Commission's activities from its establishment until the end of the fiscal year 1956/57 (31 March 1957). The report includes information on the preparations for the peaceful use of atomic energy that preceded the Act of 21 December 1955.

The present document is a translation of the Commission's first annual report. In Chapter II some paragraphs containing background information on international co-operation have been left out. Annex 3 of the Danish edition has also been omitted.

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Chapter I

Activities of the Danish Atomic Energy Commission

A. Appointment of the Atomic Energy Commission

1. Preparations for the peaceful use of atomic energy in Denmark

Apart from very limited deposits of peat and brown coal, Denmark has to rely on imports of all of its energy requirements. This dependence upon foreign supplies has been increasing rapidly: total Danish energy consumption (power and heat) has multiplied four fold in the last 40 years. At the same time, price trends have raised the cost of meeting these energy requirements. Denmark's imports of fuel, etc. amounted to more than 1,600 million kroner in 1956, as against less than 656 million kroner i 1949.

After World War II, it became apparent that the practical application of atomic energy had opened up completely new opportunities in industry, technology and science; it was therefore desirable that Denmark should participate in the work of exploiting atomic energy at the earliest possible stage. While Norway, with its production of heavy water, in co-operation with the Netherlands which had access to uranium, and while Sweden, which had exploited indigenous deposits of uranium, already put small reactors into operation in 1951 and 1954, respectively, the international political situation and the consequent considerations of military security prevented Denmark from obtaining uranium for regular research and development purposes. During that period, Denmark therefore had to concentrate its efforts on active participation in international scientific co-operation in nuclear psysics which is of fundamental importance to technical progress. This work, which was in accordance with the established traditions of Danish physical science, also served the purpose of providing opportunities for Danish scientists and technicians to acquire insight and experience which would be useful in the future developments. The situation did not change until President Eisenhower, on 8 December 1953, proposed in the United Nations to end the atomic armaments race and to institute international co-operation in the peaceful use of atomic energy; his proposal implied that countries not possessing uranium might obtain supplies of it.

After President Eisenhower's speech in December 1953, a committee was set up on 23 February 1954 under the Royal Danish Academy of Technical Sciences and with financial support from the Thomas B. Thrige Foundation, to consider Denmark's participation in the peaceful application of atomic energy. Professor Niels Bohr became chairman of the committee.

In the autumn of 1954, when there seemed to be definite possibilities,

also for Denmark, to obtain uranium, the Working Party and other interested circles decided that active work for industrial application of atomic energy should be taken up in Denmark.

One of the reasons was that even though in the future Denmark might have to purchase important components for atomic power stations from abroad, it would be necessary for us in any case - and then at an inopportune moment - to undertake a considerable amount of work on our own in order to ensure that such purchases could be made on the best possible terms and then, at a later stage, to construct and to operate the stations. It was further emphasized that the development of atomic energy in numerous fields of natural science and technology would become of such crucial importance that countries not taking part in this work would be decisively handicapped.

Against this background, the government set up a Preparatory Commission on 8 March 1955 to prepare an active Danish effort to exploit atomic energy for the benefit of the Danish community.

As a result of the work done by the Preparatory Commission, agreements were reached with the United Kingdom and the United States of America in the summer of 1955, for co-operation in the peaceful use of atomic energy, see below under B 2.

2. Act of 21 December 1955 on an Atomic Energy Commission

In order to cope with the exigencies of future scientific and technical research in medicine, biology, geology, agronomics, etc. and in certain aspects of technology and industry, the Government felt it necessary to establish a formal organisation which could command adequate expert knowledge in science and technology. This organisation would also undertake the co-operation with similar institutions in other countries and with international organs in these fields. In the light of experience gathered in the United States and the United Kingdom, the Government also felt that the permanent atomic energy commission should be constituted by an Act of Parliament; see the introductory comments on the Bill reproduced in Annex 1 to this Report.

In pursuance of Act No. 312 of 21 December 1955 an Atomic Energy Commission was set up to promote the peaceful use of atomic energy in the public interest. As the Commission's scope of activities would come within the jurisdiction of several government departments, the Commission was placed under the Ministry of Finance rather than under one of the specialized Government departments. The Act is reproduced in Annex 2 to this Report.

Section 2 of the Act provides that the number of members in the Commission is to be fixed by the Minister of Finance. He will also appoint the members for periods of three years; in consultation with the Commission, the Minister appoints its chairman and vice-chairman. The Commission is to comprise representatives of scientific and technological research and of the most important sectors of the community concerned with the peaceful use of atomic energy. In consultation with the Commission the Minister of Finance shall appoint from among its members an Executive Committee to be in charge of its current activities and the research establishments necessary therefore. The Executive Committee may have up to seven members, one of whom shall be appointed its chairman by the Minister of Finance after consultation with the Committee. Rules governing the relationship between the Commission and the Executive Committee shall be approved by the Minister of Finance.

3. Composition of the Commission

When the Act had been adopted, the Minister of Finance appointed the individual members of the Commission by letters of 24 January and 31 January 1956. The Commission was composed of the following:

A.K. Bak, D. Sc. (Techn.),
Director, Copenhagen Power Supply.

Professor T. Bjerge, Ph.D.,
Technical University of Denmark.

Professor Niels Bohr, Ph.D.,
Institute for Theoretical Physics,
University of Copenhagen.

H.P. Christensen, D.Sc. (Techn.),
Director of Helsingør Shipyard.

J. Hartz, M. Sc., (Eng.),
Director, Messrs. Thomas B. Thrige, Odense.

Professor Robert Henriksen
Director, NESA, Hellerup.

Professor J.C. Jacobsen, Ph.D.,
Institute for Theoretical Physics.

Mr. Eiler Jensen,
Chairman, Confederation of Danish Trade Unions.

Professor Sigurd Tovborg Jensen,
Royal Veterinary and Agricultural College.

Professor Tage Kemp, M.D.,
Institute of Genetics, University of Copenhagen.

H.H. Koch,
Permanent Under-Secretary of State,
Ministry of Social Affairs.

Niels Munck, M. Sc. (Eng.),
Director, Burmeister & Wain's Engineering and
Shipbuilding Co. Ltd.

Jens Møller,
Director, Vestkraft, Esbjerg.

Mærsk Mc-Kinney Møller,
Ship-owner, A.P. Møller Mærsk Line, Copenhagen.

Ivar Nørgaard, M. Sc., (Econ.),
Principal, Esbjerg Folk High School.

Peder Nørgaard,
Director, Star Brewery, Copenhagen.

Mogens Pagh,
Director, The East Asiatic Co. Ltd., Copenhagen.

Professor Axel Pedersen,
Royal Veterinary and Agricultural College.

Professor Ebbe Rasmussen, Ph.D.,
Royal Veterinary and Agricultural College,
(as from 1 Sept. 1956, Professor at the Institute
for Theoretical Physics, University of Copenhagen).

Professor R.E.H. Rasmussen, Ph. D.,
Laboratory for Applied Physics,
Technical University of Denmark.

Professor P. Brandt Rehberg, Ph. D., M.D.,
Zoophysiological Laboratory, University of Copenhagen.

H. Stevenius-Nielsen, M. Sc. (Eng.),
Director, Danish Sulphuric Acid and Superphosphate Manufacturing Co. Ltd., Copenhagen.

Haldor Topsøe, M. Sc. (Eng.),
Hellerup.

Professor Sven Werner, Ph. D.,
Institute of Physical Sciences, University of Århus.

The Minister of Finance appointed Professor Niels Bohr, Ph. D., chairman and Professor Robert Henriksen vice-chairman of the Commission.

Professor H. Bjerge and Professor J.C. Jacobsen withdrew from the Commission upon their appointment on 1 April 1956 as Administrative Leaders of the Commission's research programme and Research Director for the Commission, respectively.

The Minister of Finance has since appointed

Professor A. Noe-Nygaard, Ph. D.,
Mineralogical Museum, University of Copenhagen, and

Sigurd Pedersen, M. Sc. (Eng.),
Director, F.L. Smidth & Co. Ltd., Copenhagen

to the Commission.

The following members were appointed to the Executive Committee:

H.P. Christensen, D. Sc. (Techn.),

Professor Robert Henriksen,

Eiler Jensen,

H.H. Koch,

Professor Ebbe Rasmussen, Ph. D.,

Professor P. Brandt Rehberg, Ph. D., M.D.,

H. Stevenius-Nielsen, M. Sc.

H.H. Koch was appointed chairman of the Executive Committee.

The Commission held its first meeting on 13 February 1956. Up to the close of the financial year of 1956/57 it had held eight meetings. In the same period, the Executive Committee held 41 meetings.

4. The Atomic Energy Committee of the Folketing

The Folketing follows the Commission's work through a committee established by decision of 2 March 1956. This committee receives reports from the Commission and keeps in touch with the progress of the programme through periodical verbal inquiries or visits, etc.

The committee was composed of the following members [x]:

V.A. Heising, M. Sc. (Eng.), City Councillor, Copenhagen,
Alsing Andersen, former Minister, Frederiksberg,
O.E. Einer-Jensen, Trade Union President, Frederiksberg,
Jens Hansen, Town Hall Custodian, Århus,
Erhard Jacobsen, M. Sc., (Econ.), Copenhagen,
M. Larsen, Engine Driver, Kolding,
Hans Rasmussen, Trade Union President, Copenhagen,
Jørgen Gram, Farm Owner, Ankergaard, near Gabøl,
Marius Buhl, Grammar School Principal, Tørring,
K. Damsgaard, Agricultural Adviser, V. Skerninge,
S. Karlskov Jensen, Agricultural Adviser, Vejle,
Miss Helga Pedersen, High Court Judge, former Minister, Copenhagen,
Baron Axel Reedtz-Thott, Gaunø near Næstved,
E.P. Foss, M. Sc., (Eng.), Charlottenlund,
Ole Bjørn Kraft, former Minister, Copenhagen,
K.E.S. Rager, Director, City Councillor, Copenhagen.

5. Co-ordination Committee

As the government departments concerned with the peaceful use of atomic energy are not directly represented on the Commission, a Co-ordination Committee was set up with representatives from the Commission on one side and the government departments and agencies whose responsibilities are connected with the work of the Atomic Energy Commission on the other side. This Committee, which was established on 31 January 1956, consists of the following members:

E. Dige,
Permanent Under-Secretary of State for Finance.

Erling Kristiansen,
Deputy Under-Secretary of State for Foreign Affairs.

J.H. Zeuthen,
Permanent Under-Secretary of State, Ministry of Interior.

J. Frandsen, M.D.,
Director, National Health Administration.

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x) After the General Election on 14 May 1957, the following members retired: Jens Hansen, Town Hall Custodian; Jørgen Gram, Farmer; S. Karlskov Jensen, Agricultural Adviser; E.P. Foss, Civil Engineer; and K.E.S. Rager, Manager. They were replaced by: Aage Fogh, Secretary, Roskilde; Jens Foged, Agricultural Adviser, Hammerum; Axel Kristensen, Manager, Copenhagen; Niels Andersen, Assistant Manager, Silkeborg; and Svend Aage Fanger, Director, Civil Engineer, Århus.

Erik Ib Schmidt,
Head of The Economic Secretariat.

H. Jespersen,
Permanent Under-Secretary of State, Ministry of Commerce.

Palle Christensen,
Permanent Under-Secretary of State, Ministry of Public Works.

P. Stahlschmidt,
Permanent Under-Secretary of State, Ministry of Agriculture.

Miss A. Vøhtz,
Permanent Under-Secretary of State, Ministry of Education.

Otto Müller,
Director, Directorate of Supply.

The chairman of the Co-ordination Committee is Mr. E. Dige of the Ministry of Finance. The chairman of the Executive Committee attends meetings of the Co-ordination Committee on behalf of the Atomic Energy Commission.

B. Activities of the Commission up to 31 March 1957

1. Introduction

In the course of the preparatory work in connection with the peaceful use of atomic energy, it was found - as mentioned above - that it would be possible, through agreements with other countries (notably the United States and the United Kingdom), to secure sufficient uranium to commence research work in Denmark. After conclusion of the necessary agreements with those countries, the Commission's primary tasks were to place contracts for a research reactor and to acquire sites for laboratories, workshops, administrative offices and other facilities required for the establishment of a reactor research centre. These tasks, which necessarily dominated the Commission's activities during its first year of existence, also involved the initiation of experimental work, provisionally in plant cultivation by means of gamma radiation, radioactive isotopes, etc., in collaboration with the Ministry of Agriculture, the Royal Veterinary and Agricultural College, and the Government Committee on Animal Husbandry and the Government Committee on Plant Cultivation. In co-operation with the Ministry for Greenland, the Armed Forces, and the Geological Survey of Greenland the Commission has also conducted explorations for radioactive minerals in South Greenland. Participation in international co-operation for the peaceful use of atomic energy was also among the principal tasks of the Commission.

The Commission's activities in these fields will be described in the following sections, while international co-operation will be discussed in Chapter II.

2. The agreements with the United States and the United Kingdom on co-operation in the peaceful use of atomic energy

As mentioned in Section A, the work of the Preparatory Atomic Energy Commission resulted, in June 1955, in agreements with the United States and the United Kingdom on co-operation in the peaceful use of atomic energy; these agreements paved the way for construction of research reactors in Denmark with the necessary laboratories, workshops, etc.

Under the Danish-American agreement, the United States will supply information on the construction and operation of research reactors. A supplementary agreement was concluded on 28 June 1956 under which the United States will supply Denmark with uranium enriched 20 per cent and containing a total of 12 kilograms of uranium 235, as well as lesser amounts of highly enriched uranium 235, uranium 233 and plutonium.

The agreement with the United Kingdom provides for assistance to Denmark in the design of a research reactor and for its supply with enriched uranium. In continuation of the close relations that have existed for many years between British and Danish nuclear research, the agreement with the United Kingdom also contains provision for the planning of a joint research programme of mutual interest to the two countries.

3. Contracts for the purchase of two reactors from the United States

On 29 August 1955, tenders for the supply of a reactor were received from a number of American firms. After representatives of the Danish Atomic Energy Commission had made two visits to the United States to negotiate with the concerns that had submitted bids, a contract was signed in the summer of 1956 with the Foster Wheeler Corporation of New York for a research reactor with up to five megawatts thermal effect, corresponding to a maximum neutron flux of about 4×10^{13} thermal neutrons per cm^2 per sec. in the reactor core.

The reactor, designated DR2, is a light water moderated and cooled reactor for a maximum of 5000 kW. The reactor tank, which is of aluminium, has a diameter of 2 m (7 feet) and is about 8 m (27 feet) high. The reactor core is placed in the lower portion of the tank; it consists of fuel elements with enriched uranium (20 per cent of U-235). The individual fuel elements are box-shaped, having a cross section of about 8 x 8 cm (3 5/32 x 3 5/32 inches) and a length of about 60 cm (2 feet), containing plates of uranium-aluminium alloy, covered on either side with aluminium. Each fuel element is expected to be usable until about 10 to 15 per cent of its content of U-235 has been exhausted. If the reactor works round the clock at 5000 kW, each element will last for about 150 days.

The reactor has 17 different experimental holes of varying capacity. The physical properties of a light water moderated reactor causes the flux to diminish rather rapidly as the distance from the reactor core increases. The size of research objects that can be exposed to neutron radiation is therefore limited, but the reactor is well suited for testing of materials on a lesser scale, for the production of radioactive isotopes and for the supply of neutron rays. It is less suitable for radiation of fuel elements e.g. for power reactors during simultaneous testing of cooling media because such experiments require a high neutron flux over a considerably greater area than that which can be obtained in a light water reactor. The best way to increase the available volume is to use heavy water.

The reactor is housed in a steel tank of about 25 m (85 feet) diameter and 17 m (57 feet) high. Automatic controls and elaborate safeguards have been developed on the basis of American experience so as to limit the risk of mishaps as far as humanly possible.

The contract price of this reactor was $ 315.000. In addition, extra parts, replacements, assistance with erection, etc. will bring the total cost to about $ 354.000. According to the contract, the reactor components are to be delivered during the summer of 1957, and the reactor is due for completion by the end of 1957.

The United States' Government will contribute $ 350.000 towards the cost of this reactor and the necessary laboratories, but the amount will not be paid until the erection of the reactor has been completed and approved by the United States Atomic Energy Commission, presumably at the turn of the year of 1957/58.

Another contract was concluded, also in the summer of 1956, with "Atomics International" of Los Angeles for the delivery in the spring of 1957 of a "Zero Energy Facility" given the code name of DR1. This reactor operates at low power, for the time being at 5 watts, which can later be stepped up to 500 watts with the addition of an external cooling system. The reactor core, which is surrounded by a reflector, consists of a solution of uranium sulphate in water, contained in a stainless steel globe having a diameter of 32 cm ($12\frac{1}{2}$ inches). The reflector is of graphite, 60 cm (2 feet) thick, and surrounded by a concrete shield for protection against irradiation.

The core contains about 1 kg of U-235, and as the content of U-235 is fixed at 20 per cent, there is a total of about 5 kg of uranium in the solution. Experimental facilities comprise one horizontal hole through the centre of the core and 8 horizontal holes adjacent to the core.

DR1 is intended for educational purposes and for scientific and technological experiments that can conveniently, or even best, be carried out under a low neutron flux. The advantage of DR1 for purposes of instruction is that the control system is constructed in the same way as in large reactors. Among the technological and scientific experiments are oscillation experiments for the determination of neutron absorption in given materials, production of radioactive isotopes in small quantities and exponential experiments in a facility that can be fitted on top of the reactor. By allocating a special reactor for these experiments, most of which can best be done at a low neutron flux, and for instruction purposes as well, the entire installation has been rendered more effective and flexible at a comparatively low additional cost. Naturally, there are limitations due to both DR1 and DR2 being light water reactors. Because of the safe character of this reactor, it can be installed in a small building without safety precautions on the scale required for the other reactor.

The contract price of DR1 is $ 157.000. Extra parts will bring the total cost up to about $ 161.000.

During the construction of the two reactors, staff members of the Commission have visited the two firms to discuss technical aspects of the construction in order to avoid technical discrepancies that might be difficult and costly to correct at a later stage. During these visits it was realised that certain supplies could be obtained at lower cost in Denmark, and the orders for such supplies were cancelled and considerable savings achieved.

In connection with the discussion of the reactors it may be noted that the Commission, at its last meeting before the close of the financial year, discussed the acquisition of the above-mentioned research reactor from the United Kingdom. Although the final negotiations about this reactor, which will be of the Pluto type, were not completed until the summer of 1957, it may be mentioned already in this report that the Commission agreed, in its preliminary discussions, that Danish industry should participate in the construction of this reactor to the greatest possible extent.

4. Reactor research establishment at Risø

a. Acquisition of sites

In connection with the preliminary negotiations for acquisition of a reactor from the United States, the Commission looked around for a suitable location for the reactor research centre. On having examined the existing possibilities of finding a suitable large area not too far from Copenhagen, the Commission finally decided upon the eastern shore of the Roskilde Fjord which was considered to be within a reasonable distance from the scientific and technical institutions in Copenhagen with which the reactor research station will co-operate.

To avoid the cost of buying very large areas, the Commission thought it advisable to place the reactor research establishment itself on the Risø Peninsula in Roskilde Fjord. This location had the additional advantage of being sufficiently close to Roskilde to enable the establishment to be based on that town where most of the Commission's staff members could find housing accomodation, suitable schools for their children, etc. The Parliamentary Finance Committee agreed to the proposal to purchase the Risø Peninsula and the adjoining area.

In the negotiations for surrender of land, the Commission endeavoured to reach voluntary agreements with the individual owners. For a considerable length of time, the Commission was successful in these endeavours, but it was anticipated that difficulties might arise later and jeopardize the time schedule adopted for the establishment of the research centre. The Folketing therefore passed Act No. 126 of 25 May 1956 on the expropriation of certain areas, etc. to be used for the research work in connection with the peaceful use of atomic energy. In pursuance of this Act the Minister of Finance was authorized to expropriate the necessary built-up or undeveloped areas for the construction of the Atomic Energy Commission's research establishment. Despite this provision for expropriation, the Commission succeeded in purchasing the properties by voluntary agreements except in one instance where it was necessary to resort to expropriation. The Commission purchased three farms, the Risøgård and the Oplandsgård on the Risø Peninsula, Svaleholm just south of the peninsula, a number of smaller properties and some unbuilt areas. By the end of the financial year of 1956/57, the Commission had acquired a total of about 257 hectares (642 acres), of which about 60 hectares (150 acres) will be used for agricultural research - see Section 6 below.

Negotiations were still in progress about the acquisition of an unbuilt area, a holiday centre north of the building site, and an area of 6 hectares (15 acres) on the north side of the Veddelev Peninsula south of Risø.

b. Erection of the reactor research establishment

The members of the Commission realized that they were facing many and complex technical problems. They were also aware that the building work would have to be accelerated as much as possible if Denmark was to keep pace with international competition in the application of nuclear energy. Later, when deliveries of parts for the reactors were scheduled for definite dates, it further became necessary for the Commission to plan the construction work in such a way as to ensure that the individual buildings would be completed in time, as and when reactor components became ready for installation.

In the spring of 1956, the Commission entered into an agreement with a firm of consulting engineers, Messrs. Steensen & Varming. This firm, which had taken part in the extension of the Institute for Theoretical Physics of the

Copenhagen University, was entrusted with the project for the research centre. The Commission engaged Professor Preben Hansen of the Architectural Academy as architect in collaboration with Mr. Niepoort, an architectural expert in large industrial building projects. The engineering firm of Mogens Balslev was engaged as consultants on electro-technical problems and Professor C. Th. Sørensen, landscape architect, was engaged as consultant on the green areas between the individual buildings.

Designing was begun in March 1956 and the work at Risø was started on 9 July 1956 with the construction of a main road leading down to the peninsula from Highway 6. Extensive excavation and sewage works were also started on that date.

According to present plans, the construction work will comprise the reactor building for DR2 on the Risø Peninsula, where also the laboratories connected with the operation of DR2 and later also the British reactor designated DR3 will be erected. Buildings for research laboratories, administrative offices, library, canteen, lecture hall, workshops and the necessary garages and stores will be erected east of the peninsula. On the north side of the peninsula a treatment plant will be built; it will comprise a decontamination unit for waste water, a distillation unit for water containing radioactive matter, a laundry and an incinerator. Boiler houses will be built in connection with the laboratories and the reactor building. Finally, the project comprises a separate building for DR1 and a meteorological tower with an adjacent building for meteorological measurements, both situated on the southern side of the peninsula. Whilst the above buildings are all located west of Highway 6 between the highway and Roskilde Fjord, 14 staff residences and a hostel for visitors are located east of Highway 6 on Commission property. A water works and a water tower will also be built in that area.

It was mentioned above that the building programme was co-ordinated with the contracts concluded with the American firms in order to ensure that the buildings required for the operation of the reactors could be ready when deliveries were received from the United States. The building programme was also planned with a view to enabling the research work to commence as quickly as possible, for instance by accelerating the erection of the research laboratories; by the end of the financial year these buildings had been roofed over, and the work in the laboratories began in June 1957.

When the project was started, it was decided to facilitate the construction work by building the main communication roadway first.

The next step was the levelling of the sites for the four laboratories and the boiler house, east of the peninsula. When erection of these laboratories began in the autumn of 1956, it was expected that a considerable part of the laboratories would have to be constructed in winter; the erection of the eastern boiler house was therefore accelerated so that heating could be provided during the winter. This building was completed by about the middle of December 1956.

The group of laboratories consists of four buildings, containing chemical, reactor, electronic and physical laboratories connected by a passageway which also joins up these buildings with a lecture hall and a workshop. The latter will undertake the work required in connection with the experimental setups and the construction of equipment and tools that are not made by private manufacturers.

Shortly afterwards, the erection of the administration building was begun in connection with the laboratory group, and later in the spring of 1957

buildings followed for radiation control, library and canteen. All these buildings are the same type of construction.

The first step in the building for DR1 was the construction of a roadway and a yard; by the end of the financial year 1956/57 this work had almost been completed. The foundations of the meteorological tower were likewise poured and the tower almost ready for erection. The meteorology building was also under construction.

The site for the building for DR2 had been levelled and piling work for the reactor hall and the adjoining laboratories had made good progress.

On the western shore of the peninsula, work had started on a pier to ensure easy and unobstructed access to the surrounding fjord area.

In the design of the treatment plant there were considerable problems to overcome because of the strict safety requirements imposed by the Atomic Energy Commission for decontamination of radioactive waste water. The design was not completed until the summer of 1957, but the necessary earth filling was finished by the close of 1956. The approval of a temporary arrangement for waste water decontamination will enable the laboratories, etc. to begin operating as soon as they are completed.

The water works and the water tower were still in the blueprint stage by the end of the financial year, but a temporary boring to the north of the laboratory group can supply water to the eastern section of the building site. A permanent boring with pumps for the water works has been carried out to the east of the highway.

Annex 4 gives a layout of the installation.

In the project for the research establishment, the number of employees to be housed at the plant itself was kept at the minimum required for its satisfactory operation and only 14 dwellings will be built. This means that a considerable number of other Commission employees will have to live in Roskilde. However, the housing situation in Roskilde has proved to be very difficult and many staff members will not be able to find their own housing in that town.

As homes had to be found for a number of employees already by April or May 1957, the Commission's Executive Committee - in accordance with a decision taken by the Commission - took steps to provide a number of residences in Roskilde for the staff. After consultation with the Ministry of Housing and in the light of experience gathered by members of the Commission who had previously been faced with similar problems, it was decided to build 25 prefabricated concrete-block houses on land which the Commission had acquired from Roskilde Municipality. These houses were rented to the staff at amounts fixed according to the construction costs. Building was commenced at the turn of the year and was completed in the course of May and June 1957.

c. Special remarks on the implementation of the building projects

When the research centre was started, the Atomic Energy Commission was faced with the problem of establishing, in the shortest possible time, a framework for a Danish industrial effort in the use of nuclear energy for the benefit of the community. As shown in the previous section, it was therefore essential to plan the project as efficiently and economically as possible. All matters involving Government expenditures such as a design of individual buildings, construction work, including tendering of projects and other

decisions on construction activities, were submitted to the Ministry of Housing where the services of experts were made available. The Ministry of Housing also sends representatives to the Commission's own meetings and to meetings with the consulting engineers and architects where "time and progress schedules" and matters to be submitted to the weekly meeting of the Executive Committee are discussed. The Ministry also sends representatives regularly to the internal meetings held to prepare the meetings with engineers and architects and to the weekly "site" meetings. The Ministry of Housing can thus follow the general course of building activities as well as questions of detail. One of the architects in the Ministry has been released from other duties in order to enable him to follow this project. He attends all site meetings as observer and the meetings of the Atomic Energy Commission, and he checks all vouchers before accounts are paid.

Close collaboration has also been established with the First Section of the Central Audit Department. Besides current audits of the Commission's accounts and the resulting co-operation between the Commission and the staff of the Central Audit Department, regular meetings are held between the central audit officer who is responsible for the audit of the Commission's accounts and the Head of the Commission's Secretariat. All questions arising out of the audit are discussed at the meetings.

It was realized from the start of the work that complete and full overall or detailed plans could not be presented. The special nature of this project made it necessary to obtain any information that might be required whilst building was in progress, and if the entire project had to be designed in detail and in total before the construction started, the building operations would have been delayed very considerably.

In order to take full advantage of experience gathered in other countries, it was found necessary to send the technicians engaged in the construction on visits to corresponding plants abroad, especially to Britain, Norway and Sweden. A few trips were also made to the United States to discuss the building drawings, etc. made in Denmark with the Foster Wheeler Corporation and Atomics International and to clarify technical details that could only be explained in personal discussions.

The projects were generally started by dividing the work into many contracts for which tenders were invited, either open or from invited bidders, except where the special nature of the work rendered this procedure inadvisable, but this has only been the case in few instances during this first phase of the building activity. This arrangement has proved particularly satisfactory in a job such as the research centre at Risø, which differs from other construction projects in that it is not concluded by the completion of relatively few contracts. On the contrary, it is expected to involve more than 300 contracts (at the close of the financial year 158 had been signed of which many were similar in nature). Experience gained through the invitation of tenders has enabled the Executive Committee to reach firms from which particularly favourable bids have been received and which perform satisfactory work. This has benefitted the project in subsequent contracting, both as regards quality and price.

Consistent efforts have been made to plan the building operations in such a way that the Commission has always been able to give immediate attention to any problems that might arise. This is done in the manner explained above: matters are first considered at the regular weekly meetings with the Ministry of Housing and possibly other authorities, then discussed in the weekly meetings with the consulting engineers and architects, and finally, important matters are referred to the weekly meetings of the Executive Committee. This arrangement has not only enabled the Executive Committee to follow the building

operations from week to week; it has also ensured constant co-ordination of the activities of consulting engineers and architects, construction supervisors and contractors, the Executive Committee and the staff of the Commission. The Commission as a body has also received progress reports through the minutes of Executive Committee meetings forwarded to the Commission which enabled the members of the Commission to discuss these problems in the following plenary session, together with the ordinary business of the Commission.

The Commission feels that this form of organisation, which enables its members to keep in constant touch with developments on the site, has been an important factor in the rapid progress achieved in the building programme. In the invitations for tenders, the Commission also had to insist on certain time limits for completion of the jobs, in addition to the quality requirements. The Ministry of Housing, in collaboration with the Commission's consulting architects and engineers, check the bids for the various contracts, judging the prices in the light of the Ministry's experience with other building projects. Although this work has not yet been completed, it can be said that the cost per sq. metre of floor area in the buildings already completed is very reasonable in relation to comparable projects, even without considering the advantages of lower interest charges and quick availability of the installations gained through the acceleration of the building operations.

5. Safety Problems

The use of atomic energy involves radiation hazards not known in the utilization of traditional sources of energy. The Commission has borne this aspect in mind from the outset and taken every conceivable precaution in the design. Apart from the design of the reactors themselves and the extensive and mutually independent auxiliary controls, the necessary safety can be attained by suitable spacing between the reactor and the surrounding buildings. Where such distances cannot be secured, safety can be achieved by building the reactor itself into a pressure-tight steel tank. Thus there are no safety considerations to prevent the building of real power reactors in a closely populated country like Denmark. Both DR2 and the projected British reactor (DR3) at Risø will be built into pressure-tight steel containers and this - in connection with the acquisition of the surrounding land - will ensure the greatest possible safety for the neighbourhood.

The Commission has also established a special department for radiation control to be in charge of controls and enforcement of the medical requirements for protection against radiation at the research establishment, and to exercise control over radioactive materials, waste products and effluents from the centre. This work is carried on in collaboration with the Commission's medical consultant in compliance with the recommendations of the International Commission on Radiological Protection (ICRP).

The Atomic Energy Commission maintains close consultation and collaboration with the National Health Service and radio-biological researchers and has assisted in several investigations in this field. The Commission has thus made financial contributions to a number of studies on genetic risks involved by radiation, undertaken jointly by the National Health Service and the Institute of Genetics of the University of Copenhagen. Grants have also been made for the Danish share of a study on radiation doses arising from the medical use of radioactive substances. This investigation is being undertaken by the International Commission on Radiological Protection and the International Commission on Radiological Units and Measures at the request of the United Nations' Scientific Committee on the Effects of Atomic Radiation.

Shortly after the location of the research establishment had been decided, the Radiation Control Department initiated studies and measurements of the natural background radioactivity in the Risø area and in Roskilde fjord, with a view to subsequent control activities. The investigations were conducted in collaboration with the Fishery and Maritime Survey of Denmark. Temporary laboratories were set up in one of the buildings acquired by the Commission on Risø. A fishing boat of about 10 gross register tons was purchased for the purpose of testing the water in the fjord. The investigations will become a permanent feature of the activities of the research establishment in order to prevent contamination of the neighbourhood.

6. Establishment of an agricultural research station

As mentioned above, it was planned to conduct agricultural experiments in conjunction with the reactor research establishment initially in plant culture by means of gamma radiation, isotopes, etc. In order to facilitate the collaboration between agricultural research workers and physical scientists and in view of the availability of radioactive isotopes, etc., it was found expedient to conduct this agricultural research in the immediate vicinity of the reactor research centre where the Commission's radiation control had been set up. Discussions about the form of this collaboration have been held with agricultural experts in these fields, the Ministry of Agriculture, the Royal Veterinary and Agricultural College and the National Committee on Animal Husbandry and the National Committee on Plant Production. The scientific results from seed improvement experiments, etc. will be elaborated under the auspices of the Royal Veterinary and Agricultural College and the other institutions of agricultural science.

The Commission engaged a scientific director on 15 November 1956 to take charge of the research activities planned on the land of the "Svaleholm" farm which the Commission had already bought. In addition, a seperate area has been set aside for gamma radiation of plant cultures and laboratories have been established in connection with this area. At the close of the financial year, the establishment of the agricultural research station had made good progress, and the station began to operate in March 1957.

7. Geologic studies in Greenland

On the initiative of the Preparatory Commission an expedition was sent to South Greenland in the summer of 1955 to prospect for minerals containing fissile materials. Another expedition was sent in the summer of 1956. These expeditions were planned and carried out by the Armed Forces whilst the Greenland Geologic Survey undertook the actual geological investigations in an area by Skov Fjord in South Greenland which geologists had indicated as being particularly suited. Although the expeditions were carried out at very short notice and under primitive conditions, excellent work was performed, supplemented by scintillometer flights. The Atomic Energy Commission is very grateful to the Armed Forces for this assistance which has provided information that led to the decision to extend the prospection activities in the area very considerably in the summer of 1957. The Greenland Geologic Survey will be in charge of these endeavours to develop practical possibilities for the technical extraction of uranium and thorium. The Øresund Cryolite Company has also been helpful and will place their experience in the crushing and preparation of samples at the disposal of the Commission.

With the approval of the Ministry for Greenland, the Greenland Geologic Survey has also drawn up a five-year plan for geological surveys to be under-

taken in all parts of Greenland. The main purpose of this plan is to intensify the geological mapping of Greenland as well as the prospecting for minerals containing fissile materials and any other raw materials found.

8. Other activities

From the outset, the Commission realized that the work with atomic energy would present a number of special problems that would transcend the scope of the usual technical and scientific education in Denmark and that their technical and scientific staff should be given a supplementary course in reactor physics. Accordingly, a seminar was held in August and September of 1956 for the staff, open also to engineers from power stations and industries that might be interested in nuclear energy. The seminar was directed by the technical and scientific staff of the Commission and took the form of discussion groups dealing mainly with the following aspects:

General reactor physics

Reactor instrumentation

Reactor materials

Protection against radiation

Heat transmission problems.

In connection with the discussion groups, weekly lectures were also held on the following subjects:

Industrial uses of radioactive isotopes

Power reactors

Risø research establishment

Safety problems in connection with reactors

The Danish nuclear energy programme and international efforts for the peaceful use of atomic energy

Radioactive waste products.

The Commission considers that the participants have benefitted considerably from the seminar and a similar course was held in February-March 1957.

As a matter of historical interest, the Commission wished to have a limited amount of film, showing various phases in the establishment of the research centre. For this purpose, the Commission, with the approval of the Ministry of Finance, allocated a small sum for films to be taken on location approximately every other month. No script is prepared and the films are filed for future editing. The total cost of these films will amount to 16.000 kroner. The Atomic Energy Commission has applied to the Ministerial Film Committee for a grant of one half of that amount.

Chapter II

International Co-operation

A. Co-operation in the peaceful use of atomic energy

1. Background

A speech held in the United Nations in December 1953 by the President of the United States, Dwight D. Eisenhower, induced the General Assembly of the United Nations to adopt a resolution on 4 December 1954 which approved, in principle, the establishment of an international atomic energy organisation; by the same resolution the General Assembly decided to convene an international scientific conference on atomic energy. This conference, which was attended by delegates from all parts of the world, was held at Geneva on 8-20 August 1955 and contributed appreciably towards re-establishing the traditional international scientific co-operation in this field. One year later, the Statute of the proposed International Atomic Energy Agency was adopted in New York.

During the period following the dicisive change in the political situation, international co-operation in the peaceful use of atomic energy has expanded very considerably. Endeavours to establish a framework for this co-operation were very much in evidence in the year 1956 and in the early part of 1957. They were directed partly at creating new agencies and partly at extending the scope of activities of existing agencies. Through these endeavours, co-operation has been established at a number of levels, universal, regional as well as bilateral.

The main problems considered at the international level are to provide Member countries with uranium and other essential source materials, to prevent that uranium supplied for civilian purposes is used for military ends, and to ensure protection against radiation. Insurance problems and exchanges of scientific information and technical personnel also come within the scope of such co-operation.

In the field of supplies, the efforts are concentrated on providing essential source materials, e.g. uranium, heavy water, etc. At the present time, enriched uranium is receiving special attention because this uranium, which contains more of the active isotope U-235 than natural uranium, is so far produced only in the U.K., U.S.A., and U.S.S.R.

Safety problems arise in connection with delivery of uranium from one country to another. The technical reason for these problems is that the operation of reactors will inevitably result in production of plutonium which, in principle, can be used for civil as well as military purposes. Controls on the use of this and other by-products has therefore become a problem of great significance in international trade in uranium.

Safeguards against radiation and problems relating to insurance are examples where legislative co-ordination will become essential. Unified rules in these fields offer obvious advantages and are a precondition for the development of a considerable international trade and division of labour.

In the fields more directly connected with technical aspects of the potential uses of atomic energy, the international co-operation reflects the very different stages of technical development in nuclear science reached by the various countries. This means, on one hand, that in some respects co-operation takes the form of technical and economic assistance programmes while, on the other hand, there will be economic and political limitations to the degree of openness anticipated in such co-operation. The importance of this latter aspect will increase in step with the degree to which the co-operation moves away from more general problems towards concrete questions concerning the design of e.g. power reactors.

2. The International Atomic Energy Agency

On 20-26 September 1956 a conference was held at the Headquarters of the United Nations in New York where the establishment of an international atomic energy agency was discussed. Eighty-two countries were represented at the Conference; this is the biggest number of countries that ever took part in any international conference.

In December 1954 the General Assembly had, as already mentioned, adopted a resolution concerning the establishment of an international atomic energy agency. A draft statute was submitted to the General Assembly of the United Nations in the autumn of 1955, but the draft was referred to a committee of 12 representatives, mostly from countries having a considerable production of uranium. The result of this committee's deliberations was submitted to the conference in the shape of a draft statute establishing an atomic energy agency. The Statute was adopted with minor amendments.

The main tasks of the International Atomic Energy Agency are: to "accelerate and enlarge" the peaceful use of atomic energy throughout the world; to act as an intermediary between the Member countries in the exchange of services, materials, equipment, scientific information, etc.; to ensure that materials, etc. made available through the Agency are not used for military purposes; and to establish standards of health and safety in connection with the peaceful use of atomic energy. The Agency's function as an intermediary is organised in the way that Member countries may make materials, etc. available to the Agency which will then conclude agreements with those Member countries that wish to obtain assistance in the form of supplies of atomic fuel and services for realization of atomic projects. Such countries must submit detailed plans of their projects. The agency has the right to send out inspectors or to claim reports for the purpose of ensuring that Member countries comply with agreements concluded and especially that the Agency's supplies are not used for military purposes.

The Agency's Statute was signed on 26 October 1956 by 69 countries, including all the great powers, all the countries of the Eastern Bloc and Denmark, Iceland, Norway and Sweden. The Statute comes into force when it has been ratified by 18 countries, including at least three of the five great powers in the field of atomic energy: Canada, France, the Union of Soviet Socialist Republics, the United Kingdom, and the United States. Denmark ratified the Statute on 6 July 1957. On 29 July 1957 the necessary number of countries (including Canada, France, USSR, UK, and USA) had ratified the Statute which came into force on that day.

3. Regional co-operation in Europe

Regional co-operation in the peaceful use of atomic energy is organised in Europe under (i) the Steering Committee for Nuclear Energy established by decision adopted on 18 July 1956 by the Council of Ministers of the Organisation for European Economic Co-operation (OEEC); (ii) the European Atomic Energy Community (EURATOM) established by the so-called Messina Powers (Belgium, France, West Germany, Italy, Luxembourg, and the Netherlands) by a treaty signed in Rome on 25 March 1957; this treaty was prepared at the same time as the treaty for the European Economic Community signed by the same countries.

A third organisation, the European Atomic Energy Society, was established in 1954 as a contact agency for the atomic energy authorities of the participating countries. The Council of Europe has also concerned itself with the peaceful use of atomic energy; in a number of resolutions the Council has urged the European countries to promote regional co-operation wherever possible. In Scandinavia, Nordic co-operation in this field has been the subject of preliminary discussions which led to the adoption of a recommendation to the Nordic governments by the Nordic Council at its session in Helsingfors, Finland, in February 1957.

a. OEEC

The work of the Organisation for European Economic Co-operation in the field of nuclear energy is still at the preparatory stage, but the general framework has now been established.

By decision of 18 July 1956 OEEC's Council of Ministers established a Steering Committee for Nuclear Energy to ensure the implementation of the Council's decisions and to submit recommendations to the Council concerning such action as is found necessary to promote co-operation among the Member countries.

Two Study Groups have been set up under the auspices of the Steering Committee, viz.

a) a Study Group for the setting up of a joint undertaking for the chemical processing of irradiated fuels in order that their contents of uranium and plutonium may be separated and used in reactors;

b) a Study Group on Experimental Reactors for co-operation in the erection and testing of one or several new types of reactors and in the joint operation of a research reactor for the testing of materials.

Several Working Groups are likewise operating under the auspices of the Steering Committee:

c) to examine the possibilities of establishing one or more joint power reactors;

d) to examine general economic and legal problems involved by the establishment and operation of joint undertakings;

e) to examine the question of security control; this Working Group has been instructed to prepare the establishment of a control organisation for the Member countries;

f) to prepare co-operation in the field of training;

g) concerned with legislative co-ordination, primarily on matters relating to third-party liability in relation to atomic risks. (An Insurance Sub-Committee of OEEC's Joint Trade and Payments Committee is studying questions of insurance arising out of the use of atomic energy);

h) concerned with measures for the protection of health.

The Steering Committee is also represented on the committee which, in collaboration with OEEC's Steering Board for Trade, is considering the liberalisation of trade in commodities which are of interest to the atomic energy industry. Finally, it has been suggested that a standardisation committee should be set up, but the Steering Committee has put this suggestion in abeyance because this aspect has already been taken up for joint consideration by the International Standards Organisation and the International Electrotechnical Commission.

Denmark is a member of OEEC's Steering Committee for Nuclear Energy and takes part in the work of the above-mentioned study groups and the working groups concerned with security control, training, measures for the protection of health, legislative co-ordination and insurance problems, and the working group set up to study economic and legal problems involved by joint undertakings. Denmark is not a member of the working group concerned with the potential establishment of joint power reactor plants.

b. EURATOM

The conference of ministers of the six Member countries of the European Coal and Steel Community (Belgium, France, West Germany, Italy, Luxembourg and the Netherlands), held at Messina in the summer of 1955, decided to prepare proposals for establishment of a common European market and European co-operation in atomic energy. Such proposals were submitted to the foreign ministers of the Six Countries at a meeting held in Venice, Italy, in late May 1956. On the basis of these proposals, the foreign ministers decided that negotiations should be initiated with a view to the drafting of the treaties required for the implementation of the plans. These negotiations were opened in Brussels in late June 1956 and were completed in Rome on 25 March 1957 when treaties were signed establishing the European Economic Community and the European Atomic Energy Community (EURATOM). It is expected that the treaties will have been ratified by all the participating countries early in 1958.

The Treaty establishing the EURATOM provides for a wider range of co-operation than that which is planned within the OEEC. Thus, the Treaty contains provision for establishment of an Agency with exclusive right of concluding contracts for the purchase and sale of ores, source materials and special fissionable materials coming from inside or from outside the Community. The Agency will also be in charge of the special fissionable material which, under the terms of the Treaty, will become the joint property of the participating countries. The Six Countries have further agreed to initiate a joint 5-year research programme and prepared a budget of $ 215 million for the implementation of this programme. In addition, the Treaty contains provisions for co-ordination of research and training of technicians.

Denmark is not a member of EURATOM, but the Danish authorities have expressed a desire to avail themselves of the access provided for non-Member countries to take part in the work of an EURATOM Study Group on the Production of Enriched Uranium on equal terms with Member countries.

c. Co-operation between OEEC and EURATOM

A liaison committee has been appointed with a view to achieving the widest

possible co-ordination of the activities of OEEC and EURATOM. All the members of the latter organisation are also Members of OEEC. The Liaison Committee consists of representatives of ten countries of which five are Members of EURATOM and five (including Denmark) are Members of OEEC only. The relationship between the two organisations will hardly be defined in precise terms until the EURATOM-treaty comes into force.

d. European Atomic Energy Society

This organisation was established on Norwegian initiative on 15 June 1954 for the purpose of promoting co-operation in the research and technique of atomic energy as well as exchange of technical information between the West European atomic energy commissions and similar bodies. The Members of the European Atomic Energy Society are Belgium, Denmark (which joined it in August 1955) France, West Germany, Italy, the Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, and the United Kingdom. The supreme authority of the organisation is a Council which meets once a year. A Working Group is in charge of EAES's current activities. The Vice President of EAES is the Chairman of the Working Group.

The European Atomic Energy Society operates primarily through meetings where subjects of common interest are discussed, and through circulation of technical reports. The cost of these activities is financed individually by the participating organisations.

e. Nordic co-operation

At its fourth session in Copenhagen, the Nordic Council adopted a recommendation on 3 February 1956 based on a document submitted by the Norwegian Government, urging the Member governments to set up a co-operation committee to study the possibilities of extended Nordic co-operation in atomic research and the peaceful use of atomic energy and to prepare such co-operation where ever it might serve useful purposes.

The Co-operation Committee, composed of government representatives, parliamentarians and the responsible atomic energy agencies of the five Nordic countries, met in Stockholm on 17 November 1956 and in Copenhagen on 5 January 1957, upon which the Committee submitted a report to the governments. In its report x) the Committee suggests that in order to avoid duplication of effort, Nordic co-operation should be incorporated in other international activities in this field and provision should be made for participation also by non-Nordic countries. Since the wider international co-operation is still in the formative stage, it is difficult to say what aspects, if any, should be taken up on a Nordic Basis. Hence, the Co-operation Committee did not wish to prepare any specific programme but proposed that a Liaison Committee be set up to follow plans and activities in the field of atomic energy and to promote such possibilities of Nordic co-operation as might develop. In the opinion of the Co-operation Committee, the Liaison Committee should not have more than two members from each country; these members should primarily represent the responsible national atomic energy agencies. The Co-operation Committee's report was discussed at the fifth session of the Nordic Council at Helsingfors where a recommendation was adopted asking the governments "to set up a joint Liaison Committee for questions relating to atomic energy; the Liaison Committee shall follow closely the planning and activities in the field of atomic energy and promote the resulting possibilities of Nordic co-operation, including industrial co-operation in the field of reactors".

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x) With respect to basic research, reference is made to para B 3 below.

The Minister of Finance has appointed Permanent Under-Secretary of State H.H. Koch and Director H. Stevenius-Nielsen to represent Denmark on the Liaison Committee. The administrative chief of the Research Centre, Professor T. Bjerge, has been appointed expert adviser to the Liaison Committee, which held its first meeting in Copenhagen on 7 June 1957.

B. Co-operation in basic research

1. Introduction

Basic research is a factor of paramount importance in the further development of atomic energy for peaceful uses. The entire foundation on which our knowledge in this field is built is still so new that basic research may be expected to yield results that may exert decisive influence on the future possibilities of technical application of nuclear energy. All the industrialised countries are therefore devoting considerable amounts of manpower and finance to basic research.

As in other branches of science, physical science has a long tradition for close (usually informal) co-operation among scientific personnel and institutions in all parts of the world. In Denmark, which has been one of the leading countries in this field, the Institute of Theoretical Physics, established in 1920 under the leadership of Professor Niels Bohr, has been the centre of theoretical studies in this field. The new research institutions which are now being established in Scandinavia and other parts of Western Europe reflect the growing demands on the experimental facilities required for theoretical nuclear research; experience has also shown that research in physical science with its far-reaching ramifications is most successful in a research milieu of a certain size. Small countries can only attain these advantages through international co-operation.

2. Conseil Européen pour la Recherche nucleaire (CERN)

The European Council for Nuclear Research (CERN) was established in 1953 to erect a modern research station for basic research in nuclear physics. Two particle accelerators (one of which is of very big dimensions) are under construction at Geneva; the smaller machine is scheduled to be ready for operation in the course of 1957.

A group of scientists employed by CERN has been working at the Institute of Theoretical Physics for the last five years, but it will move to Geneva in the course of 1957.

Denmark, Norway and Sweden are Members of CERN together with Belgium, France, West Germany, Greece, Italy, the Netherlands, Switzerland, the United Kingdom and Yugoslavia. The present staff numbers approximately 400; by 1960 it is expected to reach about 500. An amount of 120 million Swiss francs has been appropriated for the period up to 1960, but an application has been made for an additional sum of approx. 80 million Swiss francs. The Member countries pay their contributions in fixed percentages of the annual costs.

3. Nordic co-operation in basic research

As mentioned in a previous paragraph, the Nordic Co-operation Committee was also asked to examine the possibilities of extended Nordic co-operation in basic research.

In its report to the governments the Committee suggested that steps should

be taken at the earliest possible date - irrespective of other decisions on Scandinavian co-operation in atomic energy - to establish a Nordic Institute for Nuclear Research. The Committee proposed that a Governing Board be set up with a maximum of three scientific representatives from each of the Nordic countries. The Governing Board should manage the Institute and promote Scandinavian co-ordination of basic research.

At its fifth session, held in Helsingfors in February 1957, the Nordic Council adopted the following recommendation to the Member governments: "to establish a Nordic Institute for Nuclear Research in Copenhagen and to appoint a Board of Governors of the Institute, the Board being also the body responsible for Nordic co-operation in nuclear physical science".

The work is scheduled to begin in September 1957. It will then be possible to use the premises that become vacant when the CERN-group leaves for Geneva. At the same time, work will be started on a new building for the Nordic Institute on a site made available by the Municipality of Copenhagen next door to the Institute of Theoretical Physics.

Chapter III

Technical and Administrative Organisation

In pursuance of the Act on an Atomic Energy Commission, Article 2, para 3, the Minister of Finance, acting upon a recommendation submitted by the Commission, has approved rules governing the relationship between the Atomic Energy Commission and the Executive Committee appointed from among its members.

According to these regulations (reproduced as Annex 3 to this report), the Commission exercises supreme authority in all tasks assigned to it in accordance with existing laws and administrative regulations and within the appropriations made available by the legislative assembly. The Commission is responsible for establishing the general principles on which all its activities will be based, including the implementation of technological and scientific research in the Commission's Research Centre. The Commission is further responsible for the general policy for engagement of personnel and for submitting recommendations for the appropriations required for its activities.

The Executive Committee is responsible for the implementation of the Commission's decisions and, within the framework of the general principles laid down by the Commission, to be in charge of the execution of the tasks assigned to the Commission and to divide the work among the staff.

The Technical and Scientific Department, headed by a Research Director and an Administrative Director, is in charge of research. A Secretariat, headed by a General Secretary, is in charge of secretarial work.

The Technical and Scientific Department is divided into groups for:

Physics

Chemistry

Electronics

Reactor studies

Health Physics.

On 1 April 1957 the staff numbered 95 persons plus 3 persons working on the Commission's farm near Svaleholm and 9 persons employed in the Works Office on Risø.

The following table shows the distribution of 56 staff members working in the Technical and Scientific Department on 1 April 1957, distributed over the above-mentioned five groups:

Staff employed in	Reactor	Physics	Chemistry	Electronics	Health Physics	Total
Chemical engineers	4	-	8	-	1	13
Mechanical "	7	-	-	-	-	7
Construction "	1	-	-	-	-	1
Electrical "	3	6	-	6	4	19
Civil engineers, total	15	6	8	6	5	40
Other university graduates	-	4	2	-	1	7
Technical engineers	1	-	-	1	1	3
Draughtsmen	-	-	-	1	-	1
Laboratory assistants	-	-	-	-	2	2
Other technicians	-	2	-	-	1	3
Total	16	12	10	8	10	56

Although the Research Centre did not begin to operate until after the period under review in this report, the Commission's staff has had to cope with a considerable work load. Many staff members have been following the design of the two reactors, others have been under training in foreign research centres and educational establishments. Two staff members followed a one-year course at the International School of Nuclear Science and Engineering in the United States to study the construction and operation of reactors; such studies cannot be pursued in Denmark for some years yet. The knowledge these two staff members had acquired has proved very useful and another two staff members were sent to the course beginning in February 1957. The Commission started its research work already in October 1956 in premises rented not far from the Commission's own premises. A provisional electronics laboratory was established in the rented premises to test electronic equipment required for the Research Centre. A workshop was also set up to work on the machinery to be installed on Risø and, in collaboration with the Electronics Department, to start the production of various apparatus.

In January 1957 the Danish Distilleries kindly made premises available free of charge to the Physics Department which was thus also enabled to start its activities. The Chemistry Department succeeded in placing some of its staff members in various laboratories in Copenhagen, for instance in the Institute of Theoretical Physics and in the Isotope Centre. The Reactor Department likewise placed some staff members in institutions in Copenhagen, e.g. in the Metallurgical Department's Laboratory and in the Technical University. At a very early stage the Health Physics Department began to work in the buildings acquired at Risø. The technical and scientific staff members were thus active long before the Research Centre could begin to operate. In this way valuable time was saved, because several jobs could be completed on which the start of the activities of the Research Centre depended.

The Commission has always found it essential that the technical and scientific staff be given opportunities to take part in international conferences in the field of atomic energy in order to acquire the specialized technical

knowledge required to take part in reactor work. In all cases, however, due consideration was given to economy. The Commission has endeavoured to limit the amount of travelling to those cases where it was considered necessary for the staff members to acquire essential knowledge that could not otherwise be obtained.

When the time was drawing near for the Research Centre to begin its operations, a number of administrative problems arose, regarding the division of labour between the central administration in the Atomic Energy Commission and the local administration on Risø and the organisation of the latter. These questions are now being considered by the Commission in consultation with the Government's Organisation and Methods Board.

Chapter IV

Expenditures incurred in the Commission's activities

A. Fiscal year 1955/56.

By its letter of 31 March 1955 the Finance Committee of the Danish Folketing (parliament) agreed to make an amount of up to kr. 2 million available, in anticipation of a supplementary appropriation for the fiscal year 1955/56, to the Provisional Atomic Energy Commission, for physical, radioactive, chemical and geological investigations, planning and design, travelling expenses involved by negotiations and studies, staff, etc. required in the Commission's preparatory work. By letter of 21 October 1955 the Finance Committee further made an amount of up to kr. 800,000 available for acquisition of land near Risø.

The Commission's accounts for that fiscal year showed the following expenditures:

Cost of the Commission's activities	kr.	638,429.94
Acquisition of land, etc.	"	560,385.80
	Total kr.	1,198,815.74

B. Fiscal year 1956/57

Although only provisional estimates could be made at the beginning of the fiscal year, the Commission wanted to prepare a budget at the earliest possible time in the fiscal year and to submit the budget to the Ministry of Finance and the Parliamentary Finance Committee for approval.

On the basis of the Commission's provisional estimates, the Finance Committee, by its letter of 14 June 1956, authorized - in anticipation of a supplementary appropriation for the fiscal year 1956/57 - expenditures for the Commission's activities within the following amounts:

Cost of the Commission's activities	kr.	1,700,000
Establishment of Research Centre	"	14,000,000
Acquisition of land near Risø	"	1,750,000

By the end of the year, however, more definite estimates could be made for the current fiscal year and the Commission received the following appropriations in the Finance Act for the fiscal year 1956/57:

1. Operating expenditure

Salaries, remuneration and fees	kr.	1,100,000
Office expenses	"	160,000
Instruments	"	230,000
Participation in technical and scientific conferences, etc.	"	210,000
Training of technical and scientific staff abroad	"	150,000
Scientific investigations	"	150,000
Other expenses	"	50,000
	kr.	2,050,000
2. Construction expenditure	"	18,442,000
3. Acquisition of land near Risø, etc. (estimated)	"	2,680,000

C. Fiscal year 1957/58

The Finance Act for the fiscal year 1957/58 contains the following appropriations:

1. Operating expenditure

Salaries, wages, etc.	kr.	3,000,000
Ordinary operating expenses	"	1,250,000
Office expenses	"	400,000
Participation in technical and scientific conferences, etc.	"	300,000
Training of technical and scientific staff abroad	"	150,000
Geologic surveys	"	350,000
Farm operations	"	100,000
	kr.	5,550,000
2. Construction expenditure	"	26,250,000

The Finance Committee later authorized an additional expenditure of kr. 6,000,000 in 1957/58 in connection with the acquisition of the British research reactor PLUTO (DR3).

The above estimate of construction expenditure covers only the plant scheduled for erection in the above-mentioned fiscal years in connection with the two American reactors. Most of these installations are expected to be in

operation by the end of the fiscal year. Erection of another reactor is planned (type PLUTO, to be bought in England, cf. Chapter I, Section B 3). The total cost of the three reactors with plants and installations was not expected to exceed kr. 100 million, distributed over five years, when the two agreements were concluded with the United Kingdom and the United States. This estimate is based on available data about experience gathered in the United Kingdom.

Chapter V

Activities outside the Atomic Energy Commission relating to the peaceful use of atomic energy

The Royal Danish Academy of Technical Sciences was established in 1937 to promote technical and scientific research and the application of its results in the interests of Danish production. As mentioned in Chapter I, the preparatory work on the utilization of atomic energy in Denmark was started by the Academy which undertook a number of investigations as a result of which the Preparatory Commission was set up.

Under the auspices of the Royal Academy a committee was formed, together with a non-profit Isotope Centre, for the purpose of encouraging Danish enterprises to use radioactive isotopes and assist in the practical application of the isotopes. The leaders in charge of the Atomic Energy Commission's research programme are members of the board of the Isotope Centre.

The Society for the Industrial Use of Atomic Energy (DANATOM) was likewise sponsored by the Royal Academy. This Society was organised as a non-profit institution under the Royal Academy in order to assist Danish undertakings, including power stations, in the study, design and production of atomic reactors and accessories for generation of energy and heat, construction and operation of atomic reactor plants for the supply of heat and such other tasks as may be of interest to Danish enterprises.

In furtherance of these objects, the Society will - in co-operation with the Atomic Energy Commission:

(i) undertake studies, investigations and research on problems relating to the design and production of atomic reactors and accessories and on design, erection and operation of plants using atomic reactors for the supply of thermal energy;

(ii) provide advice and information, and possibly also instruction and training for technical personnel from enterprises; these activities will be concerned with the design, construction and operation of plants and with the planning of other practical training for such personnel.

Major Danish industrial enterprises making power or heat-generating plants or electrical and mechanical equipment, etc. are eligible for membership of the Society; the latter will also admit shipowners, transport undertakings, power and heat-generating stations. The Atomic Energy Commission and the Technical University of Denmark are also members of the Society.

The Society will communicate the results of its studies, etc. to the members, and the results may also be published in appropriate periodicals; however, any results that are of special manufacturing or operating significance must be reserved for the participating enterprises, subject to decision by the Society's Board. The Society may undertake specified jobs for its members at rates to be approved by the Board.

Introductory Comments on the Bill on an Atomic Energy Commission

On 8 March 1955 the Government set up a commission to prepare an active Danish effort to exploit atomic energy for the benefit of the Danish community.

It had become increasingly evident that the use of atomic energy would come to play a dominant role in several fields of natural science and technology so that countries not taking part in this work might see their possibilities for development being seriously jeopardized. The growing energy requirements also made it necessary for Denmark to follow - from the earliest possible stage - the progress achieved in the generation of electric power by means of atomic energy and to provide education and training facilities for scientific and technical personnel required for the operation of the plants.

Another new element in the situation was that it now seemed possible for Denmark to obtain the material required for studies on the further development of atomic energy.

As a result of the Commission's preliminary work, agreements on co-operation in the peaceful use of atomic energy were concluded with the United Kingdom and the United States in June 1955. Under the agreement with the United States, the U.S. Government undertook, inter alia, to supply Denmark with information about the design, construction and operation of research reactors and with fissile material in the form of enriched uranium for use in a research reactor. The latter could begin to operate at an early date and enable Denmark to carry out important scientific and technological investigations. The agreement with the United Kingdom, which was concluded between the United Kingdom Atomic Energy Authority and the Danish Commission, provided for the implementation of a joint programme for scientific and technological research aiming at industrial utilization of atomic energy; this agreement involved assistance in the design and construction of a research reactor of a type similar to those which were being built in the United Kingdom, and the Atomic Energy Authority would supply fissile material for the Danish reactor.

In consequence of these agreements for co-operation with the United Kingdom and the United States, Denmark would build two reactors and other research installations with workshops and laboratories premises for administrative purposes, etc. which would be required for the research work.

In order to establish these plants and to plan the future research - which would involve several branches of science, technology and industry, e.g. medicine, biology, geology, and agriculture - it would be necessary to set up an organisation with adequate scientific and technological knowledge and ability to co-operate with similar institutions in other countries and with international agencies.

In view of the wide range of tasks to be accomplished and in the light of experience gathered in the United States and the United Kingdom, the Danish Government deemed it useful to establish a legal foundation for the Atomic

Energy Commission. In this way, Danish science, the major industries, and public authorities would be able to exercise direct influence on the organisation of the peaceful use of atomic energy which is a matter of crucial interest to the entire Danish community.

Several government departments exercise jurisdiction over fields that will be affected by the utilization of atomic energy. It was therefore found preferable to make the Atomic Energy Commission responsible to the Ministry of Finance rather than to one of the specialized government departments. However, a committee will be set up to co-ordinate the activities and administration of the Commission with those of government departments and agencies which are responsible for work connected with the Commission's activities.

With regard to Article 2 of the Act on the Atomic Energy Commission, adequate representation should be ensured primarily for scientific research, power stations and industries, but the Commission's activities will also affect other sectors of the community. Representation will therefore be provided for other interested circles, for instance the labour movement which has a vital interest in the impact of the use of atomic energy on production and the labour market. The members of the Commission will be appointed for terms of three years but may be reappointed. The Commission will build up the necessary administration and establish a framework for its technological and scientific research, including the operation and magagement of the research plants.

For practical reasons, an Executive Committee will be appointed to attend to current activities.

While Article 3 authorizes the Commission to engage the necessary administrative, scientific and technical staff on lines established by the Minister of Finance in consultation with the Commission, it has been felt that the Commission's appointment of the head of administration and the head of technological and scientific research should be subject to approval by the Minister of Finance.

Annex 2.

Act No. 312 of 21 December 1955 on an Atomic Energy Commission

Article 1

For the promotion of peaceful use of atomic energy for the benefit of the community an Atomic Energy Commission shall be appointed.

Article 2

1. The number of members of the Commission shall be fixed by the Minister of Finance, who shall appoint the members for 3 years at a time and shall select the chairman and the vice-chairman of the Commission. In the composition of the Commission, representation shall be ensured for scientific and technical research and for essential public interests connected with the peaceful use of atomic energy.

2. For the purpose of attending to tasks in connection with the current activities of the Commission and the research establishments required for its work, the Minister of Finance shall appoint, in consultation with the Commission and from among their number, an Executive Committee. The Executive Committee may have up to 7 members, of whom one shall be appointed chairman by the Minister of Finance in consultation with the Committee.

3. Detailed rules for the relations between the Commission and the Executive Committee shall be approved by the Minister of Finance.

Article 3

On lines to be established by the Minister of Finance in consultation with the Commission the latter shall be authorized to engage the necessary administrative, scientific, and technical staff. Appointments of the head of the administration and the technical-scientific head of the research establishments of the Commission are, however, subject to approval by the Minister of Finance.

Article 4

1. The means required for the activities of the Atomic Energy Commission shall be voted on the annual finance bills.

2. The Commission shall submit an annual report on its activities to the Minister of Finance, who will transmit it to the Folketing.

Rules governing the relationship between the Atomic Energy Commission and the Executive Committee appointed from among its members

In pursuance of Act No. 312 of 21 December 1955 on an Atomic Energy Commission, Article 2, para 3, the Ministry of Finance hereby approves the following rules governing the relationship between the Commission and the Executive Committee appointed from among its members:

Article 1

For the purpose of these rules "Atomic Energy Commission" shall be understood to mean:

(i) The Atomic Energy Commission set up in pursuance of Article 1 of the Act, hereinafter referred to as "the Commission";

(ii) the Executive Committee appointed in pursuance of Article 2 of the Act;

(iii) the staff engaged by the Commission.

Article 2

The Commission exercises supreme authority in the responsibilities assigned to the Atomic Energy Commission in accordance with existing laws and administrative regulations and within the appropriations made available by the legislative assembly.

Article 3

The Commission is responsible for establishing the general principles on which all the activities of the Atomic Energy Commission shall be based, including the implementation of technological and scientific research in the Atomic Energy Commission's research establishments.

Article 4

The Commission shall likewise establish general principles for the engagement of the staff required for the research activities of the Atomic Energy Commission.

Article 5

The Commission shall submit to the Minister of Finance proposals for the appropriations required for implementation of the tasks assigned to the Atomic Energy Commission, and the annual accounts shall be presented to the Commission.

Article 6

The Commission shall meet as decided by itself, but not less than four times a year, and when the Chairman deems it necessary or a member requests that a meeting be held, giving his reasons for any such request.

Article 7

The Executive Committee is responsible for the implementation of the Commission's decisions and, within the general principles established by the Commission, for furthering the implementation of the tasks assigned to the Atomic Energy Commission and, in connection herewith, for laying down principles for the division of work among the staff of the Atomic Energy Commission. The Executive Committee shall also prepare a draft for the annual report mentioned in Article 4, para 2, concerning the activities of the Atomic Energy Commission and submit the draft to the Commission.

Article 8

The Executive Committee shall meet when the Chairman deems it necessary for the implementation of the tasks assigned to it or when one or more of its members request that a meeting be held, giving his or their reasons for any such request.

Article 9

The Commission has a general right to demand that questions be submitted to it for discussion and, possibly, for decision, even if such questions would be for the Executive Committee to decide in accordance with the preceding articles.

Ministry of Finance, 20 October 1956.

(signed) Kampmann

(countersigned) L. Frederiksen

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Legend:

B : Reactor Building (DR2)
E_a : Physics Laboratory
E_b : Electronics Laboratory
E_c : Reactor Engineering Laboratory
E_d : Chemical Laboratory
E_f : Isotope Laboratory
E_h : Store Room
E_i : Store Room
E_k : Store Room
E_l : Store Room
E_n : Uranium-Thorium Laboratory
E_o : Gamma Radiation Pit
E_r : Store Room
F : Workshop
G_a : Administration
G_c : Health Physics Building, Canteen and Library
G_e : Lecture Hall
G_f : Gate and Fire Station
I_a : Boiler House 1
I_b : Boiler House 2
L_a : Water works
L_b : Water-Tower
M_a : Water Treatment Plant
M_b : Tank Farm
N_a : Employee Housing and Hostel
O : Reactor Building (DR1 - Water Boiler Reactor)
P_a : Garages and Stores
P_b : Maintenance Division
RS : Meteorology Building
S : Meteorology Tower
T_a : The farm Svaleholm
T_b : Agricultural Laboratory
T_c : Agricultural Machinery House
T_d : Hot House
T_e : Control House
T_f : Gamma Radiation Area
U : Cooling Tower


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