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PROGRESS IN PEACEFUL APPLICATIONS OF NUCLEAR ENERGY
DURING THE YEAR 1968/69

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CANADA

Developments in 1968-1969 in the peaceful applications of nuclear energy in Canada

1. The past year has been one of solid progress and, in some areas, of considerable achievement in the Canadian nuclear and uranium mining industries. In the nuclear power programme, the most important development was the firm commitment by the Hydro-Electric Power Commission of Ontario to build and operate a 3000-MW nuclear power station at Douglas Point, Ontario at an estimated cost of \$760 million. This new development, known as The Bruce Generating Station, will consist of four 750-MW CANDU reactors, with the first scheduled to come into service in 1976 and the others following at yearly intervals. The installation at the Douglas Point site will thus comprise the original 200-MW Douglas Point Station, owned by Atomic Energy of Canada Limited (AECL) and operated by Ontario Hydro, and the new 3000-MW station with a nuclear steam supply system designed by AECL.
2. Steady construction progress has been made at Ontario Hydro's four-unit 2000-MW Pickering Generating Station. The current schedule calls for the reactors of Units 1 and 2 to reach criticality in 1971 and the reactors of Units 3 and 4 to reach criticality in 1972 and 1973. With The Bruce Generating Station, Ontario Hydro will have 5400 MW of nuclear capacity within its system and will become one of the world's largest producers of electricity from nuclear energy.
3. Construction of the 250-MW Gentilly nuclear power station in the province of Quebec has also progressed satisfactorily and it is scheduled to go into operation in 1971.
4. To help meet the demands of the expanding nuclear power programme in Canada and the requirements of prospective CANDU purchasers overseas, AECL was authorized early in 1969 to build a heavy-water production plant at Douglas Point with a capacity of 800 tons a year. This plant, to be operated by Ontario Hydro, is scheduled for completion in 1972-73 and will be similar in design to the 400-ton plant being built at Port Hawkesbury, Nova Scotia by Canadian General Electric Co. Ltd.

5. Construction of two 200-MW CANDU stations at the Rajasthan Atomic Power Project in India is proceeding as anticipated. Civil engineering work for one unit is virtually complete. The Unit Two reactor building structure is well advanced and many of the equipment orders have been placed. A major objective of this project is the development of indigenous capability in India. End shields, moderator heat exchangers, boilers and fuelling machine heads have all been ordered from Indian suppliers.
6. Construction of a 125-MW heavy-water natural uranium nuclear power plant being built by Canadian General Electric on a turn-key basis for the Pakistan Atomic Energy Commission is scheduled for completion in 1970. Building construction is nearly finished and major equipment is currently being installed.
7. By the end of March, 1969, seven Canadian-designed nuclear power stations in Canada and abroad were either in operation or under construction. Their total design capacity is more than 6000 MW.
8. The Commercial Products group of AECL, responsible for the processing and distribution of radioisotopes and for designing and marketing of associated equipment, established a new record this year regarding sales of Eldorado and Theratron cobalt-therapy machines. There are now more than 700 Canadian-made units in service throughout the world. The average curie strength of cobalt sources used with these machines is steadily being increased, thereby permitting shorter treatment time and hence greater utilization of the equipment. Radioactive material shipped during the year totalled 1 800 000 curies, bringing the cumulative total to nearly 10 million curies. Most of the material was ⁶⁰Co in a variety of forms.
9. Canada is also an important supplier of uranium. In accordance with its long-established practice of promoting the use of uranium for peaceful purposes only, the Canadian Government reaffirmed its policy of supplying uranium and thorium only to customers in countries with which Canada has completed a safeguards agreement or, following the entry into force of the Treaty on the Non-Proliferation of Nuclear Weapons (NPT), with customers in countries which have concluded the necessary safeguards agreement with the International Atomic Energy Agency. Details of this policy were outlined to the House of Commons in a statement made by the Honourable Otto E. Lang on June 19, 1969.

10. As a member of the Eighteen-Nation Committee on Disarmament, Canada contributed to the achievement of an agreed draft of the NPT which was presented at the April 1968 session of the General Assembly of the United Nations. Shortly thereafter, in January 1969, Canada ratified the NPT. Canada is of the view that a prolonged delay in the coming into force of the Treaty or in the ratification of it by States which have, or are reputed to have, the ability to produce a nuclear weapon within the next few years would be a lamentable setback to the cause of nuclear disarmament and of freeing the world from the menace of nuclear war.

11. Uranium production from Canada's four operating uranium mines during 1968 was an estimated 4100 tons of uranium oxide concentrates. Of this, the companies shipped 3700 tons valued at an estimated \$45 482 000, the remaining production being kept in inventory. Meanwhile, the industry proceeded with several development programmes in anticipation of the growth in demand over the next few years. Although phasing-out production at its Noric Mine temporarily, Rio Algom Ltd. announced in October 1968 that it would spend approximately \$26 million on the reactivation of additional production facilities in the Elliot Lake area of Ontario. The project will take some four or five years, if markets develop as expected, and will be carried out in two phases. Denison Mines Ltd. continued with its long-range programme of underground development aimed at increasing its production capability by the early 1970s. Eldorado Nuclear Ltd. announced in early 1968 its decision to proceed with the construction, at its Port Hope refinery in Ontario, of facilities to produce uranium hexafluoride (UF_6). In addition, construction of the zirconium production facilities of Eldorado Nuclear Ltd. at Port Hope was completed in 1968 and production began in the second quarter of 1969.

12. Uranium exploration activity in Canada continued throughout 1968 with interest being shown in most areas of known uranium occurrences as well as in several new areas not previously investigated in detail. One such new region for uranium exploration is the basin of the flat-lying Athabasca Formation in northern Saskatchewan, which is bounded on the north by Lake Athabasca and on the south east by the Wollaston Lake structural trend. Both the sandstones in the Athabasca basin and the underlying Wollaston Lake structural break are

believed to be favourable for uranium occurrences. Although activity throughout Canada may have exceeded that reached in the peak years of the early 1950s, few quantitative measurements of results were available at the end of 1968 to illustrate the success of the programmes.

13. Of particular importance to the development of an effective safeguards system was the establishment in December, 1968 of a joint Canada-USA programme for the development of safeguards instrumentation and techniques, with special reference to on-power fuelled reactors. The objectives of this development programme are:

- (a) To develop and evaluate prototype instrumentation (unattended and secure) which may be used in the safeguarding of power reactors and other nuclear facilities; and
- (b) To test tamper-resistant/tamper-indicating techniques and devices in the severe environment of an operating power reactor.

Testing of the instrumentation and techniques will be conducted on the Nuclear Power Demonstration Reactor at Rolphton, Ontario, which has used on-power fuelling successfully for a number of years.

14. In July 1969 the Government of Canada and the Government of the United States of America formally advised the Director General of the International Atomic Energy Agency of the objectives of the joint programme and offered to make available to the Agency the results that would be forthcoming.

INDONESIA

ORGANIZATION

1. A reorganization of the National Atomic Energy Agency (Badan Tenaga Atom Nasional) (BATAN) was carried out in 1967 when a programme of consolidation was launched which, due to the limited funds available, has continued into its third year. The aim of the consolidation programme was to enable a suitable five-year plan to be drawn up and implemented within the framework of the over-all Five-Year Development Plan, which was begun in April 1969.
2. In accordance with the national priorities, stress has been laid on the application of radioisotopes and of irradiation in suitable fields. These activities were mainly the concern of the scientific staff at the Pasar Djumat Research Centre near Djakarta and at the Bandung Atomic Reactor Centre. In Jogjakarta a modest but important programme of training and research in physics and electronics is being pursued, and at Serpong near Djakarta a similar programme on radiation protection.
3. The efforts to develop the use of nuclear energy in Indonesia will continue to require substantial foreign assistance in the coming years. For this purpose a co-operative agreement was signed by the Governments of France and Indonesia on 3 April 1969 and should mark the beginning of an increased level of activities. The agreement provides for the training of Indonesian personnel, the sending of French expert missions and the exchange of information. Another agreement signed on the same day provides for the execution of a uranium exploration programme in Kalimantan by the French Atomic Energy Commission.
4. Co-operative agreements have also been signed by BATAN with other government departments, namely the Public Works and Power Department, the Health Department and the National Logistics Agency. The joint efforts for which they provide include investigations of hydrology projects, the development of nuclear medicine at the Bandung General Hospital and research on food preservation by irradiation.
5. In order to advise the President on nuclear energy matters, an Atomic Energy Council was set up in October 1968 in accordance with the provisions of the Atomic Energy Act of 1964.

HIGHLIGHTS AND DEVELOPMENTS

6. 5 December 1968 was the tenth anniversary of the establishment of BATAN, formerly known as Lembaga Tenaga Atom or the Institute for Atomic Energy. The occasion was celebrated by a Presidential visit to the Pasar Djumat Research Centre and the inauguration of a cobalt irradiator. Work is now in progress on the preservation by irradiation of rice, flour, dried salted fish and other dried foods. A Visiting Seminar on Food Irradiation to South East Asia and the Far East was held by the Agency in Djakarta in January 1969, and an Agency expert on this subject is now at Pasar Djumat to provide services for a year. An Agency gamma-radiography expert is stationed at the same Centre for a period of six months.
7. The reactor at Bandung is primarily used for radioisotope production, although some research work is also carried out; in particular a research contract for work on the chemistry of labelled compounds was awarded last year by the Agency. The demand for radioisotopes, however, has increased to such an extent that it is evident that continuous operation of the reactor for 24 hours a day will soon be required. Plans to increase the maximum power level from 250 kW to 1000 kW are also under way.
8. The increased demand for radioisotopes has arisen primarily out of hydrological projects, medical applications and research on agriculture. Production of ^{82}Br and ^{24}Na for the hydrological projects so far this year has reached 133 curies, which is about ten times last year's production. Other radioisotopes produced in quantity are ^{131}I , which is produced in batches of 22 millicuries, and ^{32}P , at present produced in batches of 9 millicuries, both radioisotopes being for medical applications. Production of labelled compounds is also being developed and a continuing increase in demand is foreseen in the coming years.
9. A seminar on the Introduction of Nuclear Power held in November 1968 concluded that there is a possibility of installing a nuclear power plant in the 1980s on the island of Java.

