

GOVERNMENT



OF CANADA

REFERENCE PAPERS

INFORMATION DIVISION

DEPARTMENT OF EXTERNAL AFFAIRS

OTTAWA - CANADA

No. 102

THE DEVELOPMENT OF COBALT THERAPY MACHINES IN CANADA

A cobalt beam therapy machine as discussed in this report is a machine designed to safely house a large source of radioactive Cobalt 60 and provide a means of accurately directing its gamma rays on previously chosen parts of the human body. Gamma radiation from Cobalt 60 has a high energy, and consequently it is very penetrating and can, therefore, be used effectively in the treatment of deep seated tumours without undue damage to surface tissue.

The usual source size is around 2,000 curies of Cobalt 60. In the early stages most sources were less than 2,000 curies whereas at present there is a tendency toward higher strength sources. This no doubt is due in part to improved availability, and somewhat higher specific activity of cobalt. A Cobalt 60 source of 2,000 curies provides a dosage which is comparable in total output with a radium source worth about \$50,000,000. The cobalt source sells for about \$12,000. The largest source yet supplied for therapy by Atomic Energy of Canada Limited is about 8,000 curies. It is also the largest in the world in this type of work.

Cobalt 60 therapy machines are particularly advantageous (compared with super voltage X-ray machines) because of the very low incidence of mechanical or electrical failure. They are simple in principle and can be operated by relatively inexperienced personnel. As such they appear to be especially suited to use in underdeveloped countries where skilled technicians and maintenance personnel are scarce.

The choice of patient to treat with cobalt machines is, of course, a clinical matter to be decided by the doctors in charge. Treatments can be directed towards cure, or palliation. Cobalt therapy machines are used primarily in the treatment of cancer.

Cobalt therapy machines were first developed and built in Canada. A machine was designed by Eldorado Mining and Refining, and at about the same time a machine

REPORT OF THE

DEPARTMENT OF EXTERNAL AFFAIRS
OTTAWA, CANADA

THE REPORT OF THE

A report has been received from the Director of the Department of External Affairs, Ottawa, Canada, regarding the activities of the [illegible] in the [illegible] area. The report states that the [illegible] has been active in the [illegible] area, and has been engaged in a variety of activities, including [illegible] and [illegible]. The report also mentions that the [illegible] has been in contact with [illegible] and [illegible], and has been engaged in a variety of activities, including [illegible] and [illegible]. The report concludes that the [illegible] is a serious threat to the [illegible] area, and that the Department of External Affairs is taking steps to deal with the situation.

The report also mentions that the [illegible] has been in contact with [illegible] and [illegible], and has been engaged in a variety of activities, including [illegible] and [illegible]. The report concludes that the [illegible] is a serious threat to the [illegible] area, and that the Department of External Affairs is taking steps to deal with the situation.

The report also mentions that the [illegible] has been in contact with [illegible] and [illegible], and has been engaged in a variety of activities, including [illegible] and [illegible]. The report concludes that the [illegible] is a serious threat to the [illegible] area, and that the Department of External Affairs is taking steps to deal with the situation.

was being designed by the Saskatchewan Cancer Commission. The Eldorado machine was designed and built for sale as part of a general programme. The Saskatchewan machine was designed for use in the clinic at Saskatoon, and not for sale. The Eldorado machine was installed and put into service at the Victoria Hospital in London, Ontario, in the fall of 1951. Although it was technically first in that it was first used in the treatment of patients, the time table on the two machines was such that they may be considered concurrent in development. The balance of this report will be confined to a description of the development insofar as Eldorado Mining and Refining was concerned, since these and later units are the ones which were developed for sale.

The Eldorado Mining and Refining group was composed of a number of physicists and engineers who had been active in the sale of radium and similar products to hospitals. This group subsequently in 1952 transferred to Atomic Energy of Canada Limited and became what is known now as the Commercial Products Division of Atomic Energy of Canada Limited. The Eldorado group had also been active in the sale of radioisotopes, including Cobalt 60 produced at Chalk River.

The specific activity of a material is an indication of the amount of activity which can be enclosed in a given mass, or volume. To produce a cobalt therapy machine one must first have a source of cobalt which is physically small and will, therefore, approximate a point source. For many years doctors throughout the world had used radium teletherapy machines to treat cancer. There was, therefore, a rather obvious suggestion to go from one or two curies of radium to 1 or 2 thousand curies of cobalt by a suitable design of machine. For such quantities radium was first too expensive, and second too bulky.

The mechanical design of the machine and the preparation of cobalt in the NRX reactor were undertaken in early 1950 after many discussions with prominent radiologists in Canada and the United States. A model of the first unit was displayed at the International Congress of Radiology in London, England, in July 1950, and at that time was demonstrated to Her Majesty the Queen (the present Queen Mother). The problem of designing a container for the source which would permit of safe loading and useage, as well as provide a beam defining mechanism to direct the rays, and a shutter system to close off the radiation, was not simple, nor had it been done before. The first such unit was completed during the summer of 1951. It was, and is known as the Eldorado model and is still, with only normal refinements, being sold on the world market.

The following information was obtained from the records of the
Department of Health and Human Services, Division of
Biological Services, Washington, D.C., on the subject of
the activities of the [redacted] in the United States
and its territories, possessions, and possessions
of the United States, and the activities of the
[redacted] in the United States and its territories,
possessions, and possessions of the United States.

The following information was obtained from the records of the
Department of Health and Human Services, Division of
Biological Services, Washington, D.C., on the subject of
the activities of the [redacted] in the United States
and its territories, possessions, and possessions
of the United States, and the activities of the
[redacted] in the United States and its territories,
possessions, and possessions of the United States.

The following information was obtained from the records of the
Department of Health and Human Services, Division of
Biological Services, Washington, D.C., on the subject of
the activities of the [redacted] in the United States
and its territories, possessions, and possessions
of the United States, and the activities of the
[redacted] in the United States and its territories,
possessions, and possessions of the United States.

The following information was obtained from the records of the
Department of Health and Human Services, Division of
Biological Services, Washington, D.C., on the subject of
the activities of the [redacted] in the United States
and its territories, possessions, and possessions
of the United States, and the activities of the
[redacted] in the United States and its territories,
possessions, and possessions of the United States.

Because of a minimum of available knowledge of the protection qualities of shielding material, and some indecision on personnel radiation protection regulations, in some countries, the Eldorado model was designed conservatively. Somewhat more than adequate protection for hospital personnel was provided. This has in recent years proven to be valuable because it permits of a considerably stronger cobalt source than was originally considered.

There was reason for a good deal of confidence in the future uses and market for machines of this type. It was also apparent that there was considerable room for variety in design of the machines, to provide convenience in a variety of clinical techniques. This situation coupled with the obvious advantage of being ahead of other countries both in ability to produce suitable Cobalt 60 and in design experience, provided the incentive to design and build a more ambitious machine. This machine trade named "Theratron B" is much more massive, and is capable of precision rotation and oscillation movements. It provides a built-in treatment bed and makes possible precise fixed, multiportal and rotation treatment techniques with a minimum of lost time in patient set-up.

The first Theratron B was completed and installed in May 1953.

In the meantime substantial amounts of cobalt were entered in NRX with a view to providing supplies for quantity sales. A period of about two years is required to produce satisfactory Cobalt 60 in NRX.

The accident in NRX in December 1952 found much of the cobalt only partly processed. Some good, and some second rate sources were salvaged, but the programme received a very severe set-back. It was early 1957 before the output of Cobalt 60 from NRX again returned to normal.

During this period, companies in other countries throughout the world began to design and build cobalt therapy machines. Cobalt 60 of suitable specific activity became available in the United States. When Canada was again in a position to proceed vigorously, the position was no longer a monopoly but rather one of keen international competition. In spite of these problems very substantial progress was and is still being made. The table below indicates year by year results.

TABLE I

Atomic Energy of Canada Limited Therapy Machines

<u>Year</u>	<u>Equipments shipped</u>	<u>Total to Date</u>
1951-52	1	1
1952-53	4	5

<u>Year</u>	<u>Equipments shipped</u>	<u>Total to Date</u>
1953-54	9	14
1954-55	15	29
1955-56	15	44
1956-57	31	75
1957-58	39	114
1958-59	32	146

In the 1953 to 1956 period some of the machines were equipped with United States Cobalt 60. In the last few years many of the machines made by other companies have been equipped with Canadian cobalt.

Canadian designed and built therapy machines have now been sold and shipped to the following countries:-

Australia	Iran
Argentina	Italy
Brazil	Lebanon
Burma	Mexico
Canada	New Zealand
Ceylon	Poland
China	Puerto Rico
Cuba	South Africa
England	Spain
France	Switzerland
Germany - East	United States
- West	Uruguay
Greece	Venezuela
India	

There is still a good deal of room for expansion in the use of this method of treating cancer.

Atomic Energy of Canada Limited now offers for sale on a world wide basis more models of cobalt therapy machines than any other company. The several models are listed below.

Atomic Energy of Canada Limited Therapy Machines

Eldorado

A very high capacity unit for fixed beam and multiportal therapy.

Approximate Weight	- 7,000 pounds	Approximate Cobalt
No. of Units Shipped	- 41	Capacity - 10,000 curies

Theratron B

A high capacity unit for fixed, multiportal, and rotation therapy with many refinements for rapid treatment in larger clinics.

Approximate Weight	- 16,000 pounds	Approximate Cobalt
No. of Units Shipped	- 34	Capacity - 6,000 curies

Theratron Jr.

A medium capacity unit for fixed, multiportal, and rotation therapy intended for smaller clinics or as an additional machine in larger clinics.

Approximate Weight	- 4,600 pounds	Approximate Cobalt
No. of Units Shipped	- 68	Capacity - 1,500 curies

Eldorado G

A medium capacity unit for fixed beam and multiportal therapy.

Approximate Weight	- 2,800 pounds	Approximate Cobalt
No. of Units Shipped	- 2	Capacity - 1,500 curies

Theratron F

A new machine of high capacity for all forms of treatment providing facilities for many new techniques.

Approximate Weight	- 8,000 pounds	Approximate Cobalt
No. of Units Shipped	- 1	Capacity - 10,000 to 12,000 curies

Eldorado Super G

A new machine of high capacity for fixed beam and multiportal techniques.

Approximate weight	- 4,200 pounds	Approximate Cobalt
No. of Units Shipped	- 0	Capacity - 10,000 to 12,000 curies

The machines above are listed in the order in which they have been designed and offered for sale.

Competitive machines are offered by more than a dozen companies manufacturing in the United States, Europe, and Asia. The United States and Canada still supply essentially all of the cobalt sources for therapy machines.

At the present time more than 2,430,000 treatments have been performed using Atomic Energy of Canada Limited machines and treatments are now being performed at the rate of about 75,000 per month. A series of about 15 or 20 treatments are usually given each patient.

Note: Illustrated brochures of the various machines may be had upon request from Atomic Energy of Canada Limited, P.O. Box 93, Ottawa, Canada.

April 1959.

RP/A

Approximate Weight - 10,000 pounds
No. of Units Shipped - 100
Capacity - 10,000 units

Theratron 1

A medium capacity unit for fixed beam and rotational therapy intended for smaller clinics or as an additional machine in larger clinics.

Approximate Weight - 4,600 pounds
No. of Units Shipped - 50
Capacity - 1,500 units

Theratron 2

A medium capacity unit for fixed beam and rotational therapy.

Approximate Weight - 2,200 pounds
No. of Units Shipped - 25
Capacity - 1,500 units

Theratron 3

A new machine of high capacity for all forms of treatment providing facilities for new techniques.

Approximate Weight - 10,000 pounds
No. of Units Shipped - 10
Capacity - 10,000 units

Theratron 4

A new machine of high capacity for fixed beam and rotational techniques.

Approximate Weight - 4,200 pounds
No. of Units Shipped - 50
Capacity - 10,000 units

The machines above are listed in the order in which they have been ordered and offered for sale.

Comprehensive machines were ordered by more than a dozen countries manufacturing in the United States, Europe, and Asia. The United States and Canada still supply essentially all of the cobalt sources for therapy machines.

At the present time over 20,000 resistors have been produced under Atomic Energy of Canada Limited machines and treatment units have been ordered at the rate of about 25,000 per month. A series of about 15 or 20 treatment units usually given each patient.

Note: Illustrated brochures of the various machines are available from Atomic Energy of Canada Limited, P.O. Box 97, Ottawa, Canada.

April 1959