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LIST OF ENCLOSURES

PAGE NO.

attachments to ABC 994/11

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APPENDIX "A"

COMPANIES AND OFFICIALS VISITED BY PERSONNEL OF DIVISION OF ISOTOPES DEVELOPMENT SEPTEMBER-DECEMBER, 1962

Abbott Laboratories
North Chicago, Illinois
Mr. Fred C. Kirchmeyer, Vice Pres.

The Budd Company
Phoenixville, Pa.
Dr. John H. Buck, Vice Pres.

Chem-Trac Corporation
Cambridge 40, Mass.
Dr. Irving A. Berstein, Pres.

E. R. Squibb & Sons
New York 22, New York
Dr. Paul Numeroff, Manager
Radiopharmaceutical Services

General Electric Company
Atomic Power Equipment Department
San Jose 12, California
Mr. George White, General Manager

Iso/Serve Incorporated
Cambridge 39, Mass.
Dr. Joseph J. Fitzgerald, Pres.

New England Nuclear Corporation
Boston 18, Massachusetts
Dr. Seymour Rothchild, Pres.

Nuclear-Chicago Corporation
Des Plaines, Illinois
Mr. John H. Hennessey, Pres.

Nuclear Consultants Corporation
St. Louis, Missouri
Dr. William Konnecker, Pres.

Nuclear Materials & Equipment Corp.
Apollo, Pennsylvania
Dr. Zalman M. Shapiro, Pres.

Nuclear Science & Engineering Corp.
Pittsburgh 36, Pennsylvania
Mr. Ronald A. Brightsen, Pres.

Picker X-Ray Corporation
Cleveland 12, Ohio
Mr. Ralph Schiring, Pres.

Radiation Research Corporation
Westbury, Long Island, New York
Mr. John H. Coleman, Pres.

Technical Operations, Inc.
Burlington, Massachusetts
Dr. Marvin Schorr, Pres.

Tracerlab, Inc.
Waltham 54, Massachusetts
Mr. Richard C. Sorenson, Pres.

Union Carbide Nuclear Corporation
Tuxedo, New York
J. C. Brantley, Director of Research

U. S. Nuclear Corporation
Burbank, California
Dr. Allen M. Goldstein, Pres.

U. S. Radium Corporation
Morristown, New Jersey
Mr. E. B. Fisher, Pres.

Volk Radiochemical Company
Skokie, Illinois
Dr. Murray E. Volk, Pres.

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APPENDIX "B"

LETTERS FROM PRIVATE RADIOISOTOPE FIRMS EXPRESSING THEIR VIEWS ON AEC-INDUSTRY PARTICIPATION IN RADIOISOTOPES PRODUCTION AND DISTRIBUTION

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ABBOTT LABORATORIES SCIENTIFIC DIVISIONS

NORTH CHICAGO, ILLINOIS

December 7, 1962

Mr. John N. Maddox
Technical Assistant to the Director
Division of Isotopes Development
United States Atomic Energy Commission
Washington 25, D. C.

Dear Mr. Maddox:

It was good to have your visit at North Chicago a month ago. I am sorry that my visit to Japan made it impossible for me to be here when you came, but your session with Mr. Kirchmeyer and Mr. Leitner was useful. Certainly they welcomed this opportunity to talk with you again.

Perhaps it would be good if I could have from you specific questions on which you think Abbott could really offer a contribution. It is difficult for me, in looking over the notes made during your visit, to see what is the precise point to be illuminated.

Your discussion here touched on the relationship of private supply of radioisotopes in the United States as affected by competition from other countries and by the continued operation of AEC in a field which U. S. industry has prepared itself to handle. I believe our general views on this subject have been laid out in various communications to the Commission and, on request, to JCAE.

Looking back on the I^{131} situation, it is my own view that the U. S. position would have been strengthened if AEC had promptly discontinued production when private industry showed itself prepared to take over supplying the isotope. I am well aware of the AEC view that there should be more than one supplier. Against this, we urged that Canada, for example, already constituted a very strong second supplier. It seems to me that the uncertainty in the situation was increased, and Canada was allowed to make its way into this uncertain situation, to a large extent by the actions taken by AEC. At a time when American users might have had their attention promptly directed toward Abbott as the U. S. supplier, AEC actions prevented this redirection of attention. Finally AEC prolonged the uncertainty by reducing its prices (although its costs per millicurie must have been rising at the time), in certain ranges even to a price fractionally below our own. Users would be expected to look in the direction of Abbott, AEC, Chalk River or elsewhere to see which source would give them the best short-range advantage.

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Abbott Laboratories should not be expected to consider pricing schedules on radioisotopes which will meet any or all terms which might be offered by one overseas source or another. One should consider these sources as either partially subsidized or able to distribute their costs in such a way as to choose almost any pricing schedule they wished. (An outsider might so interpret the action of AEC in reducing its I^{131} price schedule at a time when its sales were dropping substantially). I believe Abbott and other private industrial sources should operate radioisotope sales according to the best commercial practice.

We have always felt that AEC deserves great credit for its work in isotope development. But when it comes to the commercialization of a reactor-produced isotope, we believe the isotope development program is impaired if AEC directs its activity on the basis of cost recovery or financial return. The Commission should consider its job well done if it has stimulated isotope use to the place that a radioisotope can successfully be produced commercially by private industry.

These are general comments. With regard to more specific situations, I should welcome your suggestions.

Best regards.

Sincerely yours,

Edward J. Mateon

EJM/bjr

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ABBOTT LABORATORIES, SCIENTIFIC DIVISIONS

NORTH CHICAGO, ILLINOIS

December 13, 1961

General Manager
Atomic Energy Commission
Washington 25, D. C.

Subject: Commercial Production of I^{131}

Dear Sir:

This letter is written to acquaint the Atomic Energy Commission with the present status of the manufacture of radio-iodine (I^{131}) by Abbott Laboratories. On the basis of the facts presented, we request that the Commission in the near future withdraw as a supplier of this radioisotope, inasmuch as Abbott is now prepared to handle the requirements of licensees.

Beginning in July 1960, Abbott began to produce substantially all of its own requirements for I^{131} by a process developed by its own research. On September 1, 1960, Abbott announced the availability of chemical grade I^{131}, the first reactor-produced radioisotope to be offered by an American firm. The price schedule was lower than that of the Oak Ridge National Laboratories. No difficulty has been experienced in preparing a product of uniformly high quality. It is possible to supply a product having an activity as high as 100 mc. per milliliter if needed.

It was unfortunate that Abbott was unable to capitalize immediately on their new development, because for many users the biological and medical subsidy of the Commission resulted in an irresistibly low net price for I^{131}. It was the opinion of the Commission that the subsidy should be granted only if the radioisotope had been produced in AEC facilities. We brought this situation to the attention of the Commission in our letter of October 11, 1960, wherein we urged that the Commission's discount program be immediately terminated on the ground that its continuation would stifle the development of sources of supply of radioisotopes independent of the Commission. Our request was supplemented by subsequent letters dated November 4, 1960 and December 13, 1960. Subsequently, the matter was considered by the Commission, and it was decided to terminate the Commission's Radioisotope Research Support Program effective July 1, 1961, or on the date thereafter on which a user's research grant from the Commission expires.

In spite of the adverse situation existing prior to July 1, 1961, Abbott worked diligently to consolidate its position. We now have a firm contract with a private owner of a reactor for irradiation of targets and have established that a second reactor is available to back up the first source. We are confident that these sources assure Abbott of a reliable source of I^{131}.

In addition to supplying a number of American licensees, Abbott has been furnishing I^{131} on a routine basis to the largest Japanese user.

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As is all American industry, we are grateful for the leadership and extensive contributions of AEC in isotope development. In the case of I^{131}, industry is now prepared to assume the role of supplier, and accordingly the continued production of I^{131} in the Commission's facilities has the effect of retarding the growth and development of private industry.

We believe, therefore, that Sec. 1(b) of the Atomic Energy Act of 1954, which provides that the development, use and control of atomic energy shall be directed so as to strengthen free competition in private industry, is applicable to this situation.

We understand that the Commission agrees with us on this point. Testifying before the Joint Committee on Atomic Energy during its 1961 hearings on the Development, Growth and State of the Atomic Energy Industry, Commissioner Robert E. Wilson stated:

> "Private production of radioisotopes is beginning in the United States. During 1960, the Abbott Laboratories began commercial production of iodine 131. Both general Electric and Westinghouse have started producing cobalt 60 in their test reactors. It is expected that this commercial capability can supply the entire market for radiography and radiotherapy sources which, up to now, Oak Ridge has been handling. In addition, the Martin Co., on a partnership basis with Air Reduction Co., has indicated an interest in building a radioisotope separation plant, possibly near Hanford. In isotopes, as in other areas, the Commission will continue its policy of ceasing to provide materials or services when adequate competitive commercial sources develop at reasonable prices."

- - -

The matter of discontinuance of production of I^{131} by the Commission is intimately associated, in our opinion, with the problem of AEC pricing policy. We feel that the benefits to be gained by the discontinuance of production of I^{131} by the Commission would be largely dissipated unless the Commission concomitantly modifies its present policy, as expressed in Chapter 1701, of the AEC Manual, of recovering full costs in establishing prices on sales of radioisotopes. For this reason, we request that the Commission revise its policy to the extent that it interferes with the continued encouragement of domestic radioisotope development.

The basis for our request is as follows.

If the Commission withdraws from I^{131} production, the cost of operating its radioisotope facilities would, according to the cost-recovery policy, be spread over remaining production, and prices should increase. If other isotopes are privately produced, the same reaction would follow, intensifying the deterrent effect on

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research and development of isotope uses of the remaining ORNL radioisotopes.

Isotope production is international in character. The Commission cannot raise prices for radioisotopes without turning the attention of American licensees further in the direction of foreign suppliers. These suppliers, we understand, commonly have their government as a participant, apparently on an accounting basis which does not involve cost recovery to the government.

The Atomic Energy Act of 1954 does not require the uniform adoption of a cost-recovery policy. Thus, it is provided in Sec. 81 of the statute:

> "The Commission may distribute, sell, loan, or lease such byproduct material as it owns to licensees with or without charge; Provided, however, That, for byproduct material to be distributed by the Commission for a charge, the Commission shall establish prices on such equitable basis as, in the opinion of the Commission, (a) will provide reasonable compensation to the Government for such material, (b) will not discourage the use of such material or the development of sources of supply of such material independent of the Commission, and (c) will encourage research and development."

A course of events described above would clearly work against the purpose stated in Subsection (c) of Sec. 81. Unless the goal of complete cost recovery is put aside, discouragement of research and development is bound to occur, because of increasingly higher isotope prices at ORNL.

It should be pointed out incidentally that the purpose stated in Subsection (b) of Sec. 81 would also be adversely affected. If Abbott should continue development work in the production of radio isotopes other than I^{131}, we would find our success penalized by increasingly higher prices on the many other isotopes we purchase from ORNL for radiopharmaceutical manufacture. And other radiopharmaceutical manufacturers would be similarly affected. It follows that development of isotope uses in medicine would be discouraged, contrary to the aims of the Commission as prescribed by law.

We therefore urge that an exception to the cost-recovery policy be recognized by the Commission where there is any conflict between that policy and the maximum development of radioisotopes, both in research and medicine, and in industrial production.

Yours very truly,

Edward J. Matson

EJM/df

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CONTROLS FOR RADIATION
130 Alewife Brook Parkway
Cambridge 40, Massachusetts

October 17, 1962

Dr. Glenn T. Seaborg
Chairman
U. S. Atomic Energy Commission
Washington 25, D. C.

Dear Dr. Seaborg:

I am writing to express our company's interest in assured availability of a wide range of radioisotopes from the Atomic Energy Commission at prices competitive with overseas producers.

Among its activities in the nuclear field, Controls for Radiation, Inc. is engaged in applications of radioactivity and fabrication of radiation sources. An affiliate company, ChemTrac Corporation, synthesizes isotopically labeled chemicals for use in tracer studies.

It is important to the variety of needs of our clients and to our successful operations that a prime source of many radioisotopes be assured and that prices of the basic radioactive materials be set as low as possible.

For these reasons, we hope the Atomic Energy Commission's decisions on policies of manufacture, supply, and pricing of basic radioactive materials will include evaluation of the needs of companies such as ours.

Thank you very much for your consideration.

Very truly yours,

Irving A. Bernstein
President

IAB/eal
CC: Dr. P. C. Aebersold, Director
Division of Isotope Development
Mr. F. P. Baranowski, Director
Division of Production

Appendix "B"

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GAMMA INDUSTRIES, INC.

422 Oklahoma Street Baton Rouge Louisiana

RADIOISOTOPE EQUIPMENT AND SUPPLIES FOR RADIOGRAPHY

March 10, 1963

Dr. Paul C. Aebersold
Division of Isotopes Development
U. S. Atomic Energy Commission
Washington 25, D. C.

Dear Dr. Aebersold:

Gamma Industries, at this time, uses only Iridium-192 and Cobalt-60 for preparing radioactive sources for many industrial users. This letter is being written because of our concern that the source of supply does not seem to be stable nor adequate to satisfy the trend in market requirements. The primary considerations are reliability of the reactor operations, assurance that reactor space will be available, and that maximum specific activity can be produced.

We generally subscribe to the philosophy that the Atomic Energy Commission should not compete with commercial ventures but with the reser vation that the commercial venture must provide equal or better services and facilities than available from the Commission.

Reliability of reactor operations

When General Electric and Westinghouse accepted the responsibility for Iridium-192 production there was an absurd and unreasonable amount of effort required to get approvals to use those facilities. Almost immediately, Westinghouse raised their prices so high that no organization like Gamma Industries could exist while using Westinghouse services. As you know, shortly thereafter the Westinghouse operation was shut down and irradiation services were no longer available.

This left General Electric as the only source of supply for Iridium-192 irradiation in the United States. After an extremely long period of negotiations it became possible to use the GETR for irradiations. It must be fairly stated that General Electric has on many occasions produced acceptable irradiations but there have been several cycles that the production was less than specified or that the GETR was inoperable. General Electric did arrange for irradiations at the National Reactor Testing Station MTR so minimum time was lost and Gamma Industries greatly appreciated this extra effort. It is most interesting to note in this regard that Gamma Industries has been denied the privilege of using the MTR while, within a few hours, General Electric requested and was given permission to use the MTR.

Assurance that reactor space will be available

To assure that Iridium-192 radiography laboratories can depend upon Gamma Industries as a supplier it became obvious that another reactor must be found to give some diversity to a single operation such as the GETR. The Chalk River reactor in Canada was the next closest operation so they were contacted. Over a period of many months we have found that they are completely reliable in delivering the desired activity at the promised delivery date. Until other arrangements can be made it seems mandatory to use more than the single source, the GETR, and this seems most regretable to purchase services from a foreign country when considering that those services were developed in the United States.

Maximum specific activity

Industrial radiography has been technically refined in recent years. X-ray machines operate at higher voltages, higher beam currents, and attain much higher energy emissivity. In addition to this the quality of the re-

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sulting images on the radiographs have been greatly improved by the much smaller focal spots. Some committees of our national organizations responsible for writing codes are dominated by x-ray manufacturers and sales personnel. There is some question that some code revisions have capitalized upon this feature of better image quality to make the codes more restrictive on radiography. It is not necessarily consistent that better radiography will improve the product being inspected.

With this in mind one must consider radiographs made with isotope radiption. These will almost always have less contrast than x-radiographs. Low specific activity requires larger source sizes with the accompanying larger penumbra leading to poor image quality. The only choice, at this time, to improve the isotope radiograph image quality is to seek higher specific activity which will permit smaller sources to be prepared and this can lead to shorter exposure times and improved radiograph quality. If the maximum specific activity is not attained we can surely look toward the time that isotope radiography will not be permitted on critical structures.

Cobalt-60 with specific activity up to 150 c/g is routinely available from Canada. We do not know of any U. S. production of Cobalt-60 that even approaches this. The result is that all of our radiography Cobalt is purchased in Canada. It is admitted that the quantity used is small but, again, it seems unfortunate that foreign countries observe U.S. requirements and produce accordingly while the U.S. facilities take the attitude that the customer must buy whatever they decide to produce.

Conclusion

To overcome the difficulties presented above it is suggested that the reactors in the national laboratories again be permitted to produce Iridium-192 for those manufacturing sources. The ORR has a flux of 5×10^{14} and this would give specific activity approximately 5 times that theoretically available from the GETR. Over a period of many years my experience with the ORNL has proved their reliability.

Gamma Industries would continue to use the GETR to the maximum extent possible while access to the national laboratories would permit diversity assurance of supply continuity.

This letter has been written after much hesitation for we do not wish to "pressure" you or anyone in the Commission, however, it is believed that companies like Gamma Industries provide a necessary "link" in the chain of promoting and promulgating nuclear energy utilization for the many industries. If this a true and acceptable statement then Gamma Industries is entitled to reliable reactor services.

Sincerely yours,

Harry D. Richardson
President

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GENERAL ELECTRIC COMPANY
Pleasanton, Calif.

Atomic Products Division

November 21, 1962

cc: E. B. Tremmell
G. White

Dr. P. C. Aebersold
Director, Division of Isotope Development
U. S. Atomic Energy Commission
Washington 25, D. C.

Dear Dr. Aebersold:

In response to your letter of October 1, 1961, we have described below our processed radioisotope activities and capabilities, plus our best current projection of the course which we expect to follow in pursuit of this business.

To date, we have established relatively firm plans and schedules for six to eight processed isotopes. Phosphorus-32 is now routinely available from our stock inventory. Iodine-131 should become a stock item next month. Irradiation of H-3 and C-14 target materials is tentatively scheduled to begin early in 1963 with material ready for sale beginning in late 1963 or early 1964. A developmental program aimed at establishing chemical flor sheets and product specifications has been initiated for Cr-51, Fe-59, I-123, and Hg-203. This developmental work is scheduled for completion in January, 1963, and, if successful, will be followed by routine production and sale of these radioisotopes.

In addition to the isotopes noted above, there are several others whose production, beginning in 1963, will be considered. In this category are sulfur-35, chlorine-35, calcium-45, calcium-47, manganese-54, iron-55, molybdenum-99, nickel-63, zinc-65, thallium-304 and others. The rate of progress and production schedule for these isotopes will depend on the results of technical and economic evaluations which have not yet been completed.

Tabulated below are initial production rates, production capabilities in the GETR, and preliminary availability schedules for the eight isotopes for which we have formulated actual tentative schedules. Production rates of short lived isotopes will, of course, substantially depend on customer requirements.

Isotope	Estimated Date Available For Distribution	Projected 1963* Production Rate (curies/year)	Estimated GETR* Production Capacity (curies/year)
H-3	4th Qtr., 1963	25,000	100,000
C-14	4th Qtr., 1963	20	50
P-32	September, 1962	600	▷ 1,000
Cr-51	2nd Qtr., 1963	25	▷ 50
Fe-59	2nd Qtr., 1963	2	▷ 5
I-125	2nd Qtr., 1963	10	▷ 100
I-131	December, 1962	1,000	▷ 2,000
Hg-203	2nd Qtr., 1963	50	▷ 100

No allowance is made in these figures for decay of radioisotopes between time of reactor production and time of shipment to customers. This decay factor will range from a high of over 50% for I-131 and P-32 to less then 1% for C-14. Production capacities are based on estimates of suitable reactor space which could be utilized for these programs, not on utilization of total reactor capacity.

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Perhaps it would be useful to describe briefly the market toward which we are aiming our efforts. Our market research of the processed radioisotope business is far from complete at this time, so that we may in the future have to re-evaluate our present position. In general, however, it is our intent to be primarily a bulk supplier of processed radioisotopes. We expect our customer outlets for these radioisotope products to be firms engaged in the manufacture of labeled compounds, radiopharmaceuticals and other similar radioactive preparations. In line with our position as bulk suppliers, minimum activity levels per shipment will be established for each processed radioisotope which we sell. For example, our minimum shipment of P-32 is 200 millicuries. Any inquiries for amounts which are smaller than the designated minimum will be referred to other sources of supply.

You asked what the position of the General Electric Company is in regard to the AEC continuing to market the same processed radioisotopes or if we plan to request AEC withdrawal from sales of these products. We do not feel that at this time we have sufficient knowledge or experience to make very positive statements on this subject. We believe that the Commission should continue to encourage the development of U. S. commercial sources of supply for all radioisotope products. Future AEC actions will, we hope, follow the policy not to sell by-product material to the public to the extent this material is available from private sources at reasonable prices consistent with the overall Commission policy which is set forth in paragraph 032 of Chapter 1701 of the Commission Manual. We will continue to keep the AEC advised of our activities with respect to the supply of processed radioisotopes. Our in-put, together with your knowledge of the related activities of other private firms, should permit the Commission to ascertain when commercial sources of supply and prace rates are reasonably adequate.

I hope that the information in this letter helps clarify our current activities and future plans with respect to processed radioisotopes. We will be pleased to further discuss these matters at your convenience should you so desire.

Very truly yours,

B. W. O'Rorke
Manager
Vallecitos Irradiation Services

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GENERAL ELECTRIC COMPANY
Pleasanton, Calif.

Atomic Products Division
Vallecitos Atomic Laboratory

September 6, 1962

Subject: Commercial Isotope Production

Dr. P. C. Aebersold, Director
Division of Isotopes
U. S. Atomic Energy Commission
Washington 25, D. C.

Dear Dr. Aebersold:

This letter serves to update the information which was sent to you on April 5, 1962 by our Mr. R. L. Schmidt. Total responsibility for production, processing, sale and distribution of radioisotope products has recently been transferred to my organization. This transfer represents another step in the General Electric Company's continuing effort to expand our radioisotope activities here at the Vallecitos Atomic Laboratory. Considerable progress in this direction has been made in the past few months. A brief summary of our recent successes, current activities and future plans is given below:

Cobalt -60: Production has been expanded to include 1 mm x 1 mm pellets as well as the 1 cm and 2 cm O.D. wafers which were previously available. This step has already enabled us to secure a bulk cobalt-60 order from Picker X-Ray for 25,000 curies of the pellets. Our first success in the foreign market was recently achieved when an order for 10,000 curies was secured from a Japanese firm. We are now negotiating to supply a 100,000 curie requirement for the new Japanese Radiation Processing Center.

In June we secured our first sealed source order, this one for 12,000 curies for the U. S. Naval Radiological Defense Laboratory. We are aggressively pursuing the teletherapy sealed source business especially among foreign outlets. Negotiations for supplying these sources to several manufacturers of cobalt teletherapy machines are in progress.

The current inventory of uncommitted bulk cobalt-60 in our possession is approximately 250,000 curies. Details are given in an attachment. Another 150,000 curies of material which is committed to customer orders is also in storage at our reactor. Total current inventory is therefore in excess of 400,000 curies.

Iridium-192: Current production and distribution rate is approximately 100,000 curies per year. This amount represents a fourfold increase in our customers' requirements during the last year. Sales are generally on a service irradiation basis with unit price to customers being in the range of $1.00-$1.25 per curie received by them. It is felt that production economics have substantially contributed to the rapid growth in the commercial utilization of this isotope.

Processed Radioisotopes: We have recently put on the market processed phosphorus-32 and secured our first order for this material from Nuclear Consultants Corporation. Iodine-131 processing procedures are under development and this isotope should join our line of processed isotopes later this month. Prices and specifications for both of these isotopes are attached. You will note that our development efforts on these isotopes have enabled us to substantially reduce our prices from those which were previously sent to you in April. We expect that these new low prices will enable us to favorably compete for that domestic business which is now going to AECL and other foreign suppliers.

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We have prepared proposals for supplying both processed mercury-203 and chromium-51 and expect to add these isotopes to our "routinely available" list in 2-3 months. Iodine-125, iron-59 and nickel-63 production and processing is under evaluation. Other processed isotopes to which we expect to devote some attention as soon as possible are chlorine-36, sulfur-35 and gold-198.

We had hoped to begin to produce carbon-14 and tritium in the GETR at about this time. Our justification for initiating the production of these isotopes is significantly influenced by their exclusion from Total Reactor Utilization calculations under our GETR Master Irradiation Contract with the Commission. Such an exclusion is, we understand, currently under consideration by the Commission. These programs have therefore been deferred, we hope temporarily.

It is our aim to develop a commercial radioisotope production and processing capability within the General Electric Company to service the many customers engaged in this rapidly expanding business. We sincerely appreciate the splendid cooperation which you and your staff have offered in assisting us toward this goal. I sincerely hope that we can continue to count on your guidance and counsel in the future.

Very truly yours,

E. W. O'Rorke
Manager
VALLECITOR IRRADIATION SERVICES OPERATION

Attach.

Uncommitted Bulk Cobalt-60 Inventory (Through GETR Cycle 35) July 29, 1962

Specific Activity - Curies Per Gram

Cobalt Size	0 - 10	11-25	26 - 40	41 - 55	56 - 70	71 - 85	86 - 100	101 - 115	Total
2 cm x 1 mm	930	28,040	34,230	42,580	12,070	6,370			125,220
1 cm x 2 mm	750	1,700	7,550	10,640	34,620	15,840	12,690	7,130	90,810
1 cm x 5 mm			2,500	3,450	27,900				33,850
1 mm x 1 mm	2,570	7,190	6,000						16,760
Total (All Sizes)	4,250	36,930	50,170	56,670	75,590	22,210	12,690	7,130	266,640

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Processed High Specific Activity Phosphorus-32

Specifications

Production Method	- Irradiation of Sulfur
Chemical Form	- PO_4 ion in HCL
Specific Activity	▷ 100 mc/mg
Concentration	- 20-200 mc/ml
Chemical Purity	▷ 99%
Radiochemical Purity	▷ 99% (exclusive of P33)

Price Schedule

Quantity Ordered For Delivery Within One Year Period	Net Unit Price $/millicurie
0 - 10 curies	$ 1.00
11 - 30 curies	.90
31 - 50 curies	.80
51 - 100 curies	.75
▷ 100 curies	.70

1. Prices apply to the amount of activity in each shipment at time of delivery to Buyer's destination.

2. Minimum activity per shipment is 200 millicuries.

3. All prices are F.O.B. Vallecitos Atomic Laboratory.

Processed High Specific Activity Iodine-131

Specifications

Production Method	- Irradiation of Tellurium
Chemical Form	→ NaI in $NaHSO_3$
Specific Activity	▷ 5,000 mc/mg
Concentration	- 50-400 mc/ml
Chemical Purity	▷ 99.9%
Radiochemical Purity	▷ 99.9%

Price Schedule

Quantity Ordered For Delivery Within One Year Period	Net Unit Price $/millicurie
0 - 25 curies	$ .28
26 - 50 curies	.26
51 - 100 curies	.24
101 - 200 curies	.22
201 - 300 curies	.20
▷ 300 curies	On Request

1. Prices apply to the amount of activity in each shipment at time of delivery to Buyer's destination.

2. Minimum activity per shipment is 1000 millicuries.

3. All prices are F.O.B. Vallecitos Atomic Laboratory.

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GENERAL ELECTRIC COMPANY — Atomic Products Division

Pleasanton, Calif. — Vallecitos Atomic Laboratory

August 13, 1962

Mr. W. G. Lalor, Jr.
Washington Office

Summarized below are some of our recent activities and our future aspirations in the radioisotope area. I hope that this information will be helpful in your discussions with Ernie Tremmel and others at the USAEC.

Bulk Isotopes: Through 1961 this activity consisted largely in the production of cobalt-60. More recently bulk radioisotope production and distribution has been extended to include several other elements. By the end of 1962 we expect to have in routine production approximately fifteen radioisotopes. The bulk radioisotope business consists in either (1) the direct irradiation of customer supplied targets or (2) the production, processing and distribution of isotopes from our own stock inventory. Details on specific radioisotopes are as follows:

Cobalt-60: We have extended our production of this isotope to include 1 mm x 1 mm pellets as well as the 1 cm and 2 cm O.D. wafers which we previously had available. We are therefore now able to compete with the AECL and other bulk cobalt suppliers for those customers who have a preference for the pellet type cobalt. We have already secured our first order for this pellet material from Picker X-Ray for 25,000 curies. Delivery of the first batch of material will be made in October.

The Picker order was secured in direct competition with AECL who have been Picker's prime supplier of pellet type cobalt in the past. We expect to secure a larger fraction of Picker's business as we build up our pellet stock with higher specific activity material.

Recently we were successful in securing an order from a Japanese firm for 10,000 curies of wafer type cobalt. This represents our first direct sale to a foreign customer. We are actively pursuing an order for 100,000 curies for a Radiation Processing Facility which the Japanese are building. We think that our chances of securing this order are quite good even though it is being bid against International competition including the British, Russians and the Canadians.

As of May 1962 we had an uncommitted bulk cobalt-60 material inventory of over 250,000 curies. Except for an increase in the quantity and specific activity of the 1 mm x 1mm pellets, this inventory is still reasonably accurate. A detailed summary of our current cobalt-60 inventory is attached. It should be noted that in addition to this inventory we have an additional quantity of approximately 150,000 curies of committed stock on hand. Thus our total cobalt-60 inventory at this time is roughly 400,000 curies.

Iridium-192: We are currently producing this isotope at the rate of approximately 8,000-10,000 curies per cycle, nearly 100,000 curies per year. Production economies have enabled our customers to procure this isotope for approximately $1.00-$1.25 per curie delivered to them. This price compares quite favorably with the most recent USAEC published price for this isotope, $6.00 per curie. Our iridium-192 business and that of our customers has more than tripled in the last six months. It is felt the availability of this isotope to our customers on a reliable schedule and at a low price has stimulated the growth of the industrial radiography business.

It is well to note that, by comparison, ORNL and AECL sales of bulk Ir-192 during 1961 were approximately 6,000 and 9,000 curies respectively.

Thulium-170: The application of this isotope in industrial radiography is just beginning to be developed. Current requirements are not sufficiently standardized in size or schedule to permit the production of this isotope for stock. A few orders have been filled on a one time custom order basis. Recently we shipped to the Budd Company thulium-170 sources having specific activities of up to 600 curies per gram. These are believed to be the highest specific activity Tm-170 radiography sources ever produced. We are encouraging our customers to standardize on a few source sizes if at all possible. Such action would permit stock production of these sources and would undoubtedly result in considerable savings in their preparation costs.

Phosphorus-32: The production of processed phosphorus-32 on a routine basis has just been initiated. We are now offering high specific activity processed P-32 and expect to compete for the business currently going to AECL, ORNL, the British, the Belgians and others. We have secured our first order for this isotope from Nuclear Consultants Corp. of St. Louis. We are vigorously pursuing other potential customers such as Iso/Serve, E. R. Squibb & Sons, Volk Radiochemical Co., Nickem, Abbott Labs, and Schaarz Bio Research Labs.

We have a proposal in to Abbott Labs to irradiate sulfur targets and ship to them unprocessed P-32. Abbott plans to do their own processing of this material. It is anticipated that this program will be initiated within 2-3 months.

We expect our prices and specifications for processed P-32 to compete favorably with those of present suppliers of this isotope and that a major segment of the domestic business which is currently using foreign suppliers will revert to us. Prices and specifications are attached. These prices represent a substantial reduction from the rates at which comparable material is available from either ORNL or AECL.

Iodine-131: The story on iodine-131 is essentially the same as for P-32, in that we have received management approval to proceed with the production and processing of this isotope on a stock basis. A developmental batch will be run later this month and routine production for sale and distribution should begin in September. Competitors and customers are generally the same as in the case of P-32.

For the past year we have been irradiating tellurium targets for Abbott Laboratories and shipping to them, unprocessed, the iodine-131 which is produced. It is estimated that in excess of 800 curies of unprocessed I-131 have already been delivered under this program.

The results from our development program indicate that we can offer processed iodine-131 at prices which reflect an appreciable decrease from the prices at which this isotope is currently available. Detailed prices and specifications are attached.

Other Isotopes: We expect to initiate the production of carbon-14 next month. Carbon-14 can be expected to join our line of processed bulk isotopes about January 1963. Plans have been developed for the production of tritium. This effort is dependent on our success in getting relief

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for this isotope from total reactor utilization (TRU) calculations under the Master Irradiation Contract (1034) which we have with the Commission. Production economics for tritium are such that loss in income from TRU increases could approach the potential income from the sale of the isotope which is produced. It is obvious that production cannot be undertaken under a basis which would result in such a loss of income. We believe that it is desirable to develop a private source of supply of tritium for commercial applications but cannot justify such a production program under current contractual restrictions.

We have proposals out to prospective customers for supplying other bulk processed radioisotopes which are used primarily in the radiopharmaceutical industry. These isotopes are chromium-51 and mercury-203. Initiation of the production of these isotopes is expected before the end of this year. Another isotope which we expect to have in routine production soon is iodine-125. Consideration is being given to using a dynamic "loopsule" target capsule for the production of this isotope. Such a scheme would yield a product with a radiochemical purity not presently available. We have proposals out to U. S. Radium and New England Nuclear for supplying their nickel-63 requirements. If either proposal is favorably received the production of this isotope will be initiated shortly.

We are discussing with ORNL representatives a program which would utilize the GETR for the production of curium-242. It is felt that the GETR fluxes and performance record should be strong favorable factors in securing this program for us. It is our understanding that ORNL has recommended the use of the GETR and that this recommendation is currently in Commission channels for approval.

The General Electric Company has in progress an appreciable program which is aimed at developing nuclear and chemical processes for the production of alpha emitting isotopes. Such isotopes as actinium-227 and uranium-232 are getting our major attention at this time. It is felt that alpha emitters such as those mentioned above will in the future play a significant role in such applications as neutron sources, static eliminators, and perhaps heat sources. One or more of the above isotopes, if they develop as expected, should be in routine quantity production in the GETR or other reactors in another 1-2 years.

Sealed Sources: Sealed sources fall into several major categories such as (1) cobalt radiation sources (2) teletherapy sources (3) neutron sources and (4) heat sources. A brief discussion for each of the above follows:

Cobalt Radiation Sources: Such sources may be employed in various facilities or applications such as in universities, industrial research facilities, gamma irradiators, food irradiators, etc. The sealed source can be supplied as separate units or as complete facilities. This business has in the past been dominated by AECL by virtue of their many years of experience and their in-house capability for supplying anything from a single source to an entire radiation processing facility. Main U.S. contenders are Budd Company and Picker X-Ray. We have recently started competing for this market and in June secured our first sealed source order from the U. S. Naval Radiological Defense Laboratory for four sources containing 12,000 curies of cobalt-60. We were also advised that we were low bidder, in competition with AECL, on a source for Iowa State University. To our knowledge no order for this source of 9,000 has as yet been placed.

To date we have limited ourselves to bidding on sources for which design parameters have been established by the customer. The Canadians still maintain an edge on sources of their own design in which they utilize very low specific activity cobalt material in the range of 0.5-2 curies per gram. Their reactor apparently permits them to produce large quantities of this low activity material at a rather low cost.

Teletherapy Sources: An aggressive marketing effort aimed primarily at the foreign market has just been initiated. The domestic business is pretty well covered by Budd Company, Picker and AECL. Our prime effort is to supply cobalt-60 teletherapy sources to those foreign manufacturers of therapy machines who do not have the capabilities for preparing their own sources. We expect to secure our first order in this area before the end of the year.

Neutron Sources: We foresee a marked growth in the requirements for neutron sources in the next few years. Our efforts in this area are aimed at developing neutron sources with outputs up to ten times greater than currently available. It is felt that such sources will make feasible an entirely new requirement for neutron sources in activiation analysis applications. The development of such neutron sources is directly related to our efforts to produce alpha emitting isotopes such as those which were described previously.

Heat Sources: Heat sources can be prepared from either reactor produced or fission product isotopes. Generally some chemical processing operations on the isotope to be used are required. We intend to vigorously pursue this business since we feel that the growth potential is very impressive. We have a contract through Hermin Miller's SPNSO group to develop and fabricate a 1-2 watt thulium-170 or promethium-147 fueled direct conversion device. As you know, we were unsuccessful in getting a foothold in the curium-242 source packaging program for the Surveryor mission when the Commission decided to place this work in ORNL. At the time we made our proposal for Cm-242 packaging to USAEC representatives we were encouraged to place our emphasis on developing capabilities for processing fission product isotopes such as cerium-144 or cesium-137. We heeded this advice and had submitted to the USAEC through Royal Research Corporation, a proposal for processing and packaging a 100,000 curie cerium-144 heat source. My most recent information from Royal Research is that the Commission is undecided between VAL and ORNL as the facility in which this program is to be conducted. We, of course, feel quite strongly that this program should be placed at VAL.

That about summarizes our current thoughts on various aspects of the radioisotope business. As you will note, from the writeup we are competing successfully with the Canadians for the available cobalt business and will compete with them for the other isotope business just as rapidly as we develop appropriate capabilities.

In general let me emphasize that we have in the past and shall continue to accept all legitimate orders for commercial irradiations and radioisotopes for which we have the necessary product or facility. Therefore, I would be interested to know specifically from where is Tremmel getting "pressure" to let private work into Government reactors. Perhaps Gene Fowler's forthcoming visit will yield more information on this subject. We are looking forward to some real beneficial discussions with Mr. Fowler. If, in the meantime, I can supply you with any further information about the subjects which I have touched on in this note please let me know.

T. J. Slosek
Manager - Radioisotope Marketing
VISO
:jkn

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October 1, 1962

Mr. George White
General Manager
General Electric Company
2151 South First Street
San Jose 12, California

Dear Mr. White:

I wish to make reference to a letter dated September 6, 1962, from Mr. E. W. O'Rorke providing our office with information on your radioisotope production activities and plans. Your consideration in making these details available to us is certainly helpful in better understanding the status of your production and sales program.

We are particularly interested to learn of your plans to market processed radioisotopes. Your projected entrance into this area of the radioisotope business will have an important effect on the overall radioisotope production and distribution program of the Atomic Energy Commission. Accordingly, during Mr. Slosek's and Mr. Lalor's recent visit to Germantown we requested more specific information on your plans for processed radioisotopes. In particular, we would appreciate your best information on time schedules and production levels planned for the processed radioisotopes which you now expect to market. We would also like to better understand the position of the

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GENERAL ELECTRIC
Atomic Power Equipment Department
2151 South First Street
San Jose, California

April 5, 1962

Dr. P. C. Aebersold, Director
Division of Isotopes
U. S. Atomic Energy Commission
Washington 25, D. C.

Subject: COMMERCIAL ISOTOPE PRODUCTION

Dear Dr. Aebersold:

In a letter of April 4, 1962, to General Luedecke, Mr. George White advised that General Electric will keep the Commission informed of our activities and plans in the field of radioisotopes.

Enclosed with this letter are price schedules and brief descriptions of our current and planned activities.

Please advise if we can furnish you any further information.

Very truly yours,

R. L. Schmidt, Manager
Government, Research &
Development Applications

RLS:bc

cc: E. B. Tremmel, Office of Industrial Participation

Enclosures: Information on Isotopes:
Cobalt-60 Phosphorus-32
Iridium-192 Tritium (H-3)
Thulium-170 Carbon-14
Iodine-131

COBALT-60

Form - Solid metallic sources

Sizes - 1 cm x 2 mm 1 mm x 1 mm
1 cm x 5 mm 1/16" x 1/16"
2 cm x 1 mm 1/8" x 1/"

Price Schedule	Specific Activity Curies/Gram	List Price $/Curie
	10- 25	$ 2.00
	26- 40	3.00
	41- 55	4.00
	56- 70	5.25
	71- 85	5.65
	86- 100	6.00
	101- 115	6.35
	116- 130	6.70
	131- 145	7.05
	146- 160	7.40

Discounts

The following discounts are applicable to total curies ordered for delivery in the Delivery Period indicated below provided that individual releases for shipment are made in minimum quantities of 5,000 curies:

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Quantity Ordered	Discount	Delivery Period
Less than 5,000	None	None
5,001 to 25,000	15%	6 months
25,001 to 100,000	30%	12 months
Greater than 100,000 - quoted upon request		

Handling

The above listed prices include calibration, handling of material and loading of shipping cask, including encapsulation of bulk material designed for re-opening by buyer, as necessary to meet ICC regulations. Prices do not include encapsulation as sealed sources for direct end use.

All prices are FOB Vallecitos Atomic Laboratory, Pleasanton, California, buyer to furnish shipping casks and pay transportation charges. A limited number of casks are available for rental.

Current Status

Production was initiated in 1959. 1961 shipments exceeded 100,000 curies. Delivery of previously committed material is expected to reach 150,000 curies in 1962. The current inventory of uncommitted material is approximately 250,000 curies distributed among all of the source sizes noted above. Specific activities of from 10-130 curies/gram are available in the current uncommitted inventory.

IRIDIUM-192

Form - Solid metallic sources

Sizes - 1/16" x 1/16"
1/8" x 1/32"

Price Schedule

Quantity Ordered For Delivery Within One-Year Period	List Price - $/Curie Specific Activity 0-200 c/g	201-400 c/g
0-500th curie	$2.00	$3.00
501st-1000th curie	1.50	2.25
1001th-5000th curie	1.25	2.00

Minimum charge per shipment - $500.00

Prices for single orders in excess of 5000 curies for delivery within a one-year period will be supplied on request.

Handling

The above listed prices include calibration, handling of material and loading of shipping cask, including encapsulation of bulk material designed for re-opening by buyer, as necessary to meet ICC regulations. Prices do not include encapsulation as sealed sources for direct end use.

All prices are FOB Vallecitos Atomic Laboratory, Pleasanton, California, buyer to furnish shipping casks and pay transportation charges. A limited number of casks are available for rental.

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Current Status

Iridium production on a price per curie basis, has to date been performed only in orders which exceed the 5000 curie limitation noted above. Additional production has been done on a straight service irradiation or irradiation unit (IU) basis as defined under Contract AT(10-1)-1034. Current production of Iridium-192 in the GETR is approximately 7000 curies per reactor cycle, (35 days). All current production is being performed on a custom order basis.

It is intended that in the future a nominal amount of material will be maintained in our available inventory.

Irradiation times required for up to 200 c/g material is 1-2 months.

Form - Solid metallic sources

Sizes - No standard sizes established at present time. Source size and configuration will be supplied on a custom order basis. Prices for source targets will be quoted on request.

Price Schedule

Quantity Ordered For Delivery Within One-Year Period	List Price - $/curie* Specific Activiey 0-150 c/g	141-300 c/g
0-500th curie	$3.00	$4.00
501st-1000th curie	2.50	3.25
1000th-5000th curie	2.00	2.75

*List Price does not include cost of targets.

Minimum charge per shipment - $500.00

Prices for single orders in excess of 5000 curies for delivery within a one-year period will be supplied on request.

Handling

The above listed prices include calibration, handling of material and loading of shipping cask, including encapsulation of bulk material designed for re-opening by buyer, as necessary to meet ICC regulations. Prices do not include encapsulation as sealed sources for direct end use.

All prices are FOB Vallecitos Atomic Laboratory, Pleasanton, California, buyer to furnish shipping casks and pay transportation charges. A limited number of casks are available for rental.

Current Status

All production to date has been performed on a service irradiation or I. U. basis. It is intended that future activity include sales on a price per curie basis. No inventory of this isotope will be maintained until source size requirements are standardized. Normal irradiation time required for up to 150 c/g material is 1-2 months.

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IODINE-131

Form - Processed carrier free material. Prepared and shipped as Na I in basic sodium sulfite solution.

Price Schedule

Quantity Ordered For Delivery Within One-Year Period	Net Unit Price $/Millicurie
0-20th curie	$0.35
21st-50th curie	0.31
51st-100th curie	0.28

Minimum charge per shipment - $500.00

Prices for single orders in excess of 100 curies for delivery within a one-year period will be supplied on request.

Handling

The above listed prices include calibration, handling of material and loading of shipping cask, including encapsulation of bulk material designed for re-opening by buyer, as necessary to meet ICC regulations. Prices do not include encapsulation as sealed sources for direct end use.

All prices are FOB Vallecitos Atomic Laboratory, Pleasanton, California, buyer to furnish shipping casks and pay transportation charges. A limited number of casks are available for rental.

Current Status

Production of bulk unprocessed iodine-131 has been in progress for approximately one year. Over 500 curies have been shipped to date. Processing capabilities are currently being developed and potential customers for processed material are being contacted.

PHOSPHORUS-32

Form - Processed high specific activity (>100 c/g of total phorphorus) material. Prepared and shipped as H_3PO_4 in HCL solution.

Price Schedule

Quantity Ordered For Delivery Within One-Year Period	Net Unit Price $/Millicurie
0-20th curie	$1.00
21st-50th curie	.85
51st-100th curie	.65

Minimum charge per shipment - $500.00

Prices for single orders in excess of 100 curies for delivery within a one-year period will be supplied on request.

Handling

The above listed prices include calibration, handling of material and loading of shipping cask, including encapsulation of bulk material designed for re-opening by buyer, as necessary to meet ICC regulations. Prices do not include encapsulation as sealed sources for direct end use.

All prices are FOB Vallecitos Atomic Laboratory, Pleasanton, California, buyer to furnish shipping casks and pay transportation charges. A limited number of casks are available for rental.

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Current Status

Production of bulk unprocessed material has been initiated. Processing capabilities are currently being developed and potential customers for processed material are being contacted.

TRITIUM (H-3)

Form - Processed carrier free material. Prepared and shipped as gas containing small amounts of He^3 daughter.

Price Schedule - $2.00 per curie

Minimum charge per shipment - $200.00

Handling

The above listed prices include calibration, handling of material and loading of shipping cask, including encapsulation of bulk material designed for re-opening by buyer, as necessary to meet ICC regulations. Prices do not include encapsulation as sealed sources for direct end use.

All prices are FOB Vallecitos Atomic Laboratory, Pleasanton, California, buyer to furnish shipping casks and pay transportation charges. A limited number of casks are available for rental.

Current Status

Target materials have been ordered and start of production is anticipated within a few months. Shipments of processed tritium should begin in early 1963.

CARBON-14

Form - Processed high specific activity material (>1 curie C-14 per gram total carbon). Prepared and shipped as solid $BaCO_3$.

Price Schedule

Quantity Ordered For Delivery Within One-Year Period	Net Unit Price $/Millicurie
0-1000th millicurie	$9.50
1001st-2000th millicurie	7.50
2001st-5000th millicurie	6.50

Minimum charge per shipment - $200.00

Prices for single orders in excess of 5 curie for delivery within a one-year period will be supplied on request.

Handling

The above listed prices include calibration, handling of material and loading of shipping cask, including encapsulation of bulk material designed for re-opening by buyer, as necessary to meet ICC regulations. Prices do not include encapsulation as sealed sources for direct end use.

All prices are FOB Vallecitos Atomic Laboratory, Pleasanton, California, buyer to furnish shipping casks and pay transportation charges. A limited number of casks are available for rental.

Current Status

Target materials have been ordered and start of production is anticipated within a few months. Shipments of processed isotopes should begin in early 1963.

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NEW ENGLAND NUCLEAR CORP. 575 Albany Street, Boston 15, Massachusetts

November 21, 1962

Dr. Glenn T. Seaborg
Chairman
U.S. Atomic Energy Commission
Washington 25, D. C.

Dear Dr. Seaborg:

On behalf of my organization, I would like to comment on certain aspects of the A.E.C.'s role in the production and sale of radioisotopes. Our company is one of the leading suppliers of labeled compounds and is therefore very much aware of the possible impact that a change in the A.E.C.'s policies with regard to radioisotope distribution might have not only on the industrial suppliers of labeled compounds, such as our organization, but also on the research and medical community which depends so greatly on radioisotopes to carry out its research.

The A.E.C.'s policy of being willing to transfer certain of its activities to industry, when industry is capable of performing the activities with equal efficiency and responsibility is commendable. However, on the basis of available information, we do not feel that industrial reactors offer a sufficiently assured source of supply for radioisotopes to meet our national requirements. The large investment required for the construction of reactors will always reduce the production of radioisotopes to a "by-product" role. With the present total annual sale of reactor-produced radioisotopes no more than several million dollars, and not likely to grow at an exponential rate, it would be difficult for several companies to produce and sell reactor-produced radioisotopes competitively. In our opinion, the responsibility of maintaining an assured supply of radioisotopes at a reasonable price is so great because of the vast amount of isotope-based research which is being performed, that a minimum of two responsible sources of supply must be available before private industry should be permitted to control the production and distribution of radioisotopes. The larger national interest should not be put in jeopardy by premature A.E.C. action in relinquishing control of production and distribution of radioisotopes to commercial interests.

We therefore urge you to continue A.E.C. production and distribution of radioisotopes. The efficiency and service with which the Oak Ridge National Laboratory has conducted its business has been very satisfactory. We have found those in charge responsive to suggestions and changing needs, and also alert to price competition from foreign sources of supply.

Sincerely,

NEW ENGLAND NUCLEAR CORP.

Seymour Rothchild, President

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St. Louis, Missouri
January 18, 1963

Glenn T. Seaborg, Ph.D.
Chairman
United States Atomic Energy Commission
Washington 25, D.C.

Dear Dr. Seaborg:

Today I'm afraid, we are all too quick to find fault and criticize various branches and departments within the government and slow in issuing compliments and thanks when they are in order.

May I break this precedent and offer to you, and your associates, my sincere thanks for two outstanding jobs recently performed by your organization?

The first was your reconsideration of your physical policy regarding the operations of the byproduct material processing plant at Oak Ridge. Being in business for myself I am quite aware of the desirability and necessity of an organization being financially self-sufficient. However, when such an attempt was made some months ago with the Oak Ridge operation, it resulted in price increases for most short-lived isotopes that made them financially impractical for ourselves and others in the radiopharmaceutical field to handle. It also caused all four major suppliers to look elsewhere for better prices. The result was that all of us ended up obtaining our supplies of I-131 and P-32 (Oak Ridge's largest sellers and probably most profitable short-lived products) from the Canadian AEC.

Recent changes in your pricing policy and precalibration time has made it nearly as economical to purchase our raw materials in this country. At the present time we are again purchasing all our raw materials from Oak Ridge and intend to do so as long as prices are at all competitive. I realize it is the desire of the AEC to turn the production of such short-lived materials over to commercial groups. I am 100% in agreement with this basic philosophy. I feel government should only be in those areas where a need of the general public exists - but no single or group of non-government organizations can offer these services. I feel the supply of short-lived isotopes for use in routine medical procedures and research is still one of these areas. The total volume of sales or usage is not yet to a level which can economically sustain such an operation. We can now obtain I-131 from at least one other local source. This is a competitor with a single product to sell and with a higher price than the AEC's present price.

I think, and sincerely hope, the time will come when the AEC can, and should, back away from such commercial operations. Unfortunately, the industry is not old enough (or large enough) to stand by itself and still needs the government's help to make radioisotopes available to the general medical public at a reasonable price.

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Mr. Case and his group at Oak Ridge should also be commended for the excellent job they are doing and the excellent cooperation they are displaying in attempting to serve our needs.

The second "helping hand" your group has given the field of Nuclear Medicine is in your discussions with the FDA concerning the inclusion of radiopharmaceuticals in their new regulations. Needless to say, not only the four major producers of radiopharmaceuticals but (I'm sure) all the physicians throughout the country who have come to rely on radioisotope techniques as part of their routine diagnostic and therapeutic procedures were pleased to learn the FDA had granted an 18 to 24 month delay in the inclusion of these products under their new regulations.

Again, the field is too young and too small to be able to sustain the additional costs which would have been incurred by these regulations. All drugs should most certainly be controlled. Radiopharmaceuticals are presently, I feel, most rigidly and adequately controlled by your commission. As the usage of these materials become more widespread and better understood the controls should, logically, be turned over to other agencies such as the FDA.

Again, not only in behalf of my own company but also for the many physicians with whom we are associated may I thank you for the "helping hand" you have given the field of Nuclear Medicine.

Sincerely,

NUCLEAR CONSULTANTS CORPORATION

W. R. Konneker, Ph.D.
President

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NUCLEAR SCIENCE AND ENGINEERING CORPORATION

Pittsburgh 36, Pennsylvania

R. A. Brightsen
President

January 10, 1963

Dr. Paul C. Aebersold, Director
Division of Isotopes Development
U. S. Atomic Energy Commission
Washington 25, D. C.

Dear Paul:

You will recall that, at your request, I sent you on November 1, 1962, an eight-page letter detailing our views on radioisotope production and pricing. To date I have received no reply and can only conclude that our major points were obscured by the length of the letter. To rectify this, I should like to summarize our position briefly:

1. NSEC believes the AEC should vigorously support scientifically sound and economically promising research and development projects aimed at two goals

   a. Lower production costs for isotopes now generally available

   b. Production techniques which would make available useful isotopes not presently obtainable.

   The support of such programs should depend only on the technical and economic merits of the proposal and should be independent of whether such proposals originate from private industry or government laboratories.

2. NSEC believes the AEC should withdraw from producing any isotopes that private industry is willing to produce and sell.

   This transition to the free enterprise system should be made as quickly as practicable. Any company, large or small, would then have an opportunity to enter the isotope business without fear of government competition.

The question of whether or not the U. S. should take steps to improve the U. S. share of the radioisotope market is a broader question of policy. Our letter merely states that <u>if</u> the U. S. wishes to improve its position and at the same time transfer the isotope business to private industry, there is no question but that some form of subsidy to private industry will be necessary in order to compete with foreign production.

I trust the above summary will be of assistance to you.

Sincerely,

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Nuclear Science and Engineering Corp.
P.O. Box 10901, Pittsburgh 36, Penna.

November 1, 1962

Dr. Paul C. Aebersold, Director
Division of Isotopes Development
U.S. Atomic Energy Commission
Washington 25, D. C.

Dear Paul:

It was a pleasure for us to welcome your assistant, Mr. John Maddox, to NSEC on October 18. Your initiative in seeking our views on the AEC's current and future policy on production and pricing of radioisotopes is commendable, and sincerely appreciated.

In the course of our discussions with Mr. Maddox, it became evident that the principal source of concern to your Division at this time is the declining fraction of the domestic market being supplied by AEC and other domestic suppliers of radioisotopes. Implicit in this concern, if the U. S. wishes to maintain a major role in radioisotope production and sales, is one or both of two conclusions: (1) Prices of U. S. radioisotopes must be reduced to levels competitive with those of foreign suppliers; or (2) some kind of restrictions should be placed on imported radioisotopes. The latter point relates to U. S. policy in a manner that places it beyond our detailed consideration here. Any useful discussion of the subject must assume that the United States does wish to compete in the international radioisotope market, as it has set out deliberately to do in other segments of the free world's nuclear economy. This means price reductions for those radioisotopes produced domestically, by AEC or by private industry, which are available from foreign sources in acceptable quality at lower prices.

The Commission's pricing policy is, of course, inextricably interlaced with production policy, and the latter, in turn, with the role of U. S. industry in the production and distribution of radioisotopes. These points must be considered in concert with the relevant provisions of atomic energy legislation as background. I refer specifically to Section 1(b) of the Atomic Energy Act of 1954, which declares that "the development, use, and control of atomic energy shall be directed so as to.....strengthen free competition in private enterprise," and to Section 81, which states that the Commission's prices for byproduct material "will not discourage the use of such material or the development of sources of supply of such material independent of the Commission". While the other provisions of the latter section, containing the phrases "reasonable compensation to the Government" and "encourage research and development", are subject to mutually contradictory interpretation, I believe the provision that Commission prices will not discourage development of independent sources of supply is eminently clear, and consistent with the declaration quoted from Section 1(b).

The extent to which "high" prices discourage use of byproduct material, and fail to encourage research and development, is indeterminate. The termination of the Commission's radioisotope research support program in 1961 suggests that increases in isotope prices are not believed to have a serious impact on the level of research and development. On the other hand, it is fair to conclude that "low" Commission prices will discourage private enterprise in general, and small business in particular, from becoming independent suppliers of radioisotopes; "low" prices will also discourage industry from undertaking, at its own expense, research and development on improved production methods.

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In this connection, we note the simultaneous development of iodine-125 production processes by Oak Ridge National Laboratory and NSEC. If NSEC had not already been in production of this isotope at the time ORNL's development was announced, there are good indications that we might have been substantially underpriced by the Commission under existing pricing policies as interpreted by your Division. Had NSEC's work not been so far advanced, the development of an independent source of supply might well have been delayed for several years.

In the spirit of the relevant provisions of the legislation, I believe the time has come for an orderly transition to "free competition in private enterprice". This transition should be planned so as (1) to ensure a continuing U. S. supply of radioisotopes at prices competitive in the world market; and (2) to encourage scientific and technological ingenuity as the ultimate basis of free competition. Such a planned transition would indeed encourage research and development, and competitive prices in the world market could certainly be interpreted as not discouraging the use of U. S. byproduct material.

In our discussions with Mr. Maddox, as in earlier discussions with you, it was clear that some consideration is being given to accomplishing price reductions and achieving "free competition in private enterprise" by adopting a policy whereby the Commission would limit its radioisotope sales to "bulk" quantities, with minimum quantities available to any qualified purchaser at fixed prices substantially below current unit prices. Properly implemented, such a policy could indeed accomplish the desired price reductions; but to what extent would it, in fact, promote free competition in private enterprise? Would it not indeed discourage, perhaps even prohibit, development of sources of supply independent of the Commission? Would it not patently stifle, rather than encourage, research and development in the important area of radioisotope production?

To bring these questions into focus, I believe it is essential that we agree on what is meant by "private enterprise," and "sources of supply independent of the Commission". Clearly, in the limiting situation, production and direct sale to the ultimate consumer of all byproduct materials and radioisotope products by the Commission is outside the scope of either definition. If the Commission were as a matter of policy to continue production, and adopt the "bulk" approach to sale, free competition in private enterprise would exist only in the area of packaging and resale of the radioisotopes, and the sources of supply could not conceivably be considered independent of the Commission; it could be argued in fact that the sole source of supply, for materials so produced, and sold, and resold is the Commission.

I question whether the intent of the Congress, declared in Section 1(b) of the Act, is to encourage competition only in the area of sales. The American free-enterprise economy has been based on a much firmer foundation that that provided by advertising and sales promotion alone. The competition which is vital in the economy depends on the resourcefulness of industry, stimulated by the profit motivation, in improving technology. This was clearly implicit in the report of the Joint Committee on Atomic Energy, whose report on the bill to amend the Act, in 1954, specifically asserted that "we do not believe that any developmental program carried out solely under governmental auspices, no matter how efficient it may be, can substitute for the cost-cutting and other incentives of free and competitive enterprise". Centralization of isotope production in the national laboratories not only conflicts with the policies thus expressed by the Joint Committee and the Congress; such ownership and utilization of the means of production by the Government in this manner is inconsistent with traditional American economic principles as well.

A small but important segment of the U. S. nuclear industry, of which NSEC is a part, has been investing scientific and technological talent in the development of techniques for the production and utilization of radioisotopes for a number of years. This work has been done under the profit motivation which is an essential part of free enterprise. For the Commission to offer this motivation

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to sales-oriented private enterprise while denying it to science-and technology-oriented free enterprise would not be in the national interest; it would be grossly discriminatory; it would squelch the development of sources of supply independent of the Commission; it would establish, perhaps irreversibly, a Government monopoly on the production of byproduct radioisotopes; it would perpetuate production methods which, however cleverly conceived, have not been subjected to the calculated scrutiny of competitive cost analysis by that segment of American free enterprise which has both the scientific ability and the profit motivation to reduce costs.

Clearly, you will find in American industry some who will endorse the "bulk" sales approach. Those who are already concerned only with bulk purchases, chemical or physical conversion, and resale of radioisotopes will obviously view favorably the prospect of reduced prices. Those who have extensive advertising resources, far-flung sales organizations, and available warehouse facilities, would have everything to gain and nothing to lose; potentially included here are any number of large commercial enterprises which may never yet have given a serious thought to radioisotopes or perhaps to any segment of the nuclear industry.

The position of NSEC in this discussion is probably unique, and consequently, I feel, should be given unique consideration. Our entire business is concerned with radioisotopes in one form or another. We, uniquely, have developed the capability for profitable production and sale of more than twenty-five radioisotopes, only one of which is, however, classified as a byproduct material. This capability has been developed from the ground up, with competent scientific personnel, using irradiation facilities (both private and AEC) available to others on the same terms as to us. We have demonstrated to the satisfaction of personnel of your Division that, given irradiation services at rates comparable to those booked for ORNL services in ORNL reactors, we are capable of entering the field of byproduct radioisotope production profitably at prices comparable to those established by the Commission under its "full cost recovery" policy.

As a matter of normal business procedure, we are currently exploring the availability of irradiation sources, both foreign and domestic, with a view to reducing production costs further on both byproduct and other radioisotopes. Let me distinguish clearly here between the purchase of radioisotopes and the purchase of irradiation services. It is the latter in which we are interested. We prefer to continue to develop our own scientific resources and to rely upon our own ingenuity in selection of materials for irradiation, in specifying the conditions of irradiation, and in economically processing the irradiated materials, as well as in evaluating the market potential for new radioisotope products. These are the factors on which a true free enterprise economy in radioisotopes must ultimately be based.

Whether or not we can eventually penetrate further the international byproduct radioisotope market under existing AEC policies and practices depends primarily on the availability of economical reactor-irradiation services. Obviously we will not be motivated to make the effort if our reactor-irradiation service charges are higher by an order of magnitude than those "booked" by Commission production facilities for use of Commission reactors. We may be forced to seek an economic advantage by using foreign facilities, but this procedure would have its pitfalls. It would be prejudicial to the interest of private U. S. reactor operators; it would give rise to difficulties in communication between our technical personnel and the staff at the reactor; transportation, foreign exchange, and export-import problems might be burdensome; and that segment of the U. S. market bound by "buy American" contract clauses might not be available to us.

We respectfully suggest that an effective and economically sound transition to a fully American private enterprise in the area of radioisotope production and sales can be made in an orderly, evolutionary manner over a period of several years, with the kind of support the Commission has provided to other segments of the nuclear industry. This support might take any or all of the following forms:

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1) Contracts with private industry for technically sound research and development programs in the area of radioisotopes production. Such contracts are authorized under the section of the Act which provides for the support of research on "processes entailed in the....production of (special nuclear and radioactive) material".

2) Cost-sharing in the area of irradiation charges, in private facilities to the extent these are available and adequate, otherwise in Commission facilities. It should be recognized that the high cost of irradiations in private reactors reflects interest, taxes, insurance, expenses associated with licensing, and other charges not incurred by the Government. By selling isotopes at prices which do not fully reflect these elements of cost, the Government is indirectly using public funds to stimulate increased radioisotope sales. As an alternative to this indirect price support, and to enable industry to meet the Commission's prices, we suggest that the Government provide direct financial assistance to reactor operators to enable them to provide irradiation services to industry at prices comparable to the Commission's more limited costs. To deal with foreign competition effectively, somewhat more substantial sharing of costs by the Commission may be necessary.

3) Announcement of a policy by the Commission that it will withdraw from production of any isotope when private sources of supply appear to be adequate in acceptable quality at internationally competitive prices.

4) Sale or lease of Commission facilities such as hot cells, reactors, and cyclotrons to qualified private concerns, in accordance with proposals submitted to and found acceptable by the Commission, where such facilities would be used for production of radioisotopes. To avoid establishment of monopolistic positions by individual companies, the Commission should accept such proposals only if other firms would also continue to have access to these types of facilities, either publicly-or privately-owned, at cost levels (as discussed in 2, above) which will enable them to be competitive. Also, such proposals should not be accepted if they would give a company an unfair competitive advantage over another concern which had previously used or committed its own funds to acquire similar facilities.

Implementation of each part of such a support program implies some judgments. The mechanics of judicious execution would certainly require some study and discussion, but I believe these problems are not insurmountable if we attack them in a spirit of cooperation.

The proposed transition to private enterprise should be accomplished in a manner that will be equitable to all concerned. Developments that are financed by private investment should be afforded the normal safeguards of our patent system. However, where Government funds are used to support research, the results should be made available to the Government for licensing to other United States firms. We note that NSEC has traditionally shared its know-how and technological achievements with others, even where the technology was based upon the investment of our own funds. You will, of course, recall the detailed production methods which were reported by our scientists ("Cyclotron-produced Carrier-free Radioisotopes", International Journal of Applied Radiation and Isotopes, 5, 21-31, 1959).

NSEC's proposals conform to the national policy governing governmental participation in industrial activity (as defined in Bureau of the Budget Bulletin No. 60-2), and to the Commission's repeated statements of its intention to discontinue providing materials or services which are reasonably available from commercial sources. This intention was explained by the Chairman and other officials of the Commission, during hearings on AEC authorizing legislation for

fiscal year 1963, as follows. If the Government has a specified requirement for a specific quantity of material for a specific mission on a given date, the material is one for which no commercial use is apparent, and the technology needed to meet the requirement is most advanced in a national laboratory, then the material should be obtained from the latter and not from industry. However, as Chairman Seaborg suggested, even in this type of situation, the production responsibility should be transferred to industry as quickly as possible once the "crisis" is passed. As he stated, further, "I don't think the Oak Ridge National Laboratory should or wants to be the continuing producer in a situation like this".

Under the transition program we have proposed, properly executed, NSEC not only would expect but would welcome commercial competition in radioisotope production and sales. Our interest in this program is neither academic nor rhetorical, it is vital.

NSEC was founded in 1954 by the late Gordon Dean, a distinguished former Chairman of the Atomic Energy Commission, with the expectation that Government and industry would embark upon a cooperative enterprise directed toward an ever-expanding role of industry in the nuclear field. This objective was clearly endorsed by Congress with respect to peaceful uses of atomic energy. The report of the Joint Committee on Atomic Energy, submitted just nine days before NSEC was incorporated, encouraged industry to invest in this new field with the assurance that Government's role would be supportive, rather than competitive.

Thus the drafters of the 1954 Act and the founders of NSEC both anticipated teamwork between Government and industry. While there have been many examples of such cooperation in the field of atomic power development, Commission support in radioisotope production techniques has been, to the best of our knowledge, virtually non-existent, and in the area of radioisotope applications, has been meager in comparison with the tremendous sums spent for atomic power development. Further, we are compelled to observe, with regret, that the teamwork contemplated by the Act has been increasingly neglected in favor of a monolithic Government operation in the field of our own private enterprise--the production and application of radioisotopes.

The fact that the Commission has not supported technically sound proposals for improved radioisotope production techniques and the meager support it has provided for radioisotope applications may, in our opinion, be substantially responsible for the fact that the United States is now apparently losing its paramount position in isotope production and related technology. You will recall that as early as 1958, NSEC submitted a comprehensive proposal entitled, "The Development of Improved Radioisotope Production Techniques". Despite repeated indications over the years that the program was worthy of support, according to your letter of August 24, 1962, this proposal is "no longer of interest to us in the light of our current programmatic priorities and availability of funds".

Before concluding, I should like to note that NSEC is currently planning to construct new and expanded facilities, some of which are being designed for isotope production operations. These facilities will be financed by our stockholders or by lenders who require reasonable assurance of a satisfactory return on their investment. The policies of the Commission will have a direct, and perpahs critical, bearing upon our ability to obtain the required capital to augment our capacity as a source of supply of radioisotopes independent of the Commission.

We at NSEC believe that the dismaying trends in the position of the United States in the field of isotope production and technology can be reversed in due course of time by the kind of program and policies we have outlined. The future operations of NSEC in particular, and of an important segment of the nuclear industry in general, are to a large extent dependent upon the policies now being formulated by the Commission. We hope our comments will contribute to the establishment of policies which will foster close cooperation between your Division and NSEC, in the national interest, in the years ahead.

Sincerely,
President

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OAK RIDGE NATIONAL LABORATORY
P.O. Box X
Oak Ridge, Tennessee

March 1, 1963

Mr. E. E. Fowler
Deputy Director
Division of Isotopes Development
U. S. Atomic Energy Commission
Washington 25, D. C.

Dear Gene:

The recent discussion between the U. S. Nuclear Corporation and your division concerning the fabrication of Cs^{137} sources has been brought to our attention in a telephone conversation between John Maddox and Neil Case.

As you know, there are divided feelings in the radioisotope industry on the part ORNL should play in supplying radioisotope materials and services; and oftentimes attempts are made to have restrictions placed on ORNL radioisotope production work, primarily to give some financial advantage to the petitioner. We believe that in most cases the application of such restrictions would not be in the best interest of all the secondary suppliers or of the general public. Partial loss of markets by ORNL also reduces the efficiency with which we can perform our remaining functions. For example, we have shown that the loss of a major part of the I^{131} market has increased the production costs of approximately 14 other radioisotopes that are produced from side streams of the I^{131} process.

In general, two types of commercial radioisotope business operations have evolved: one type is well-managed by reputable people with an interest in the radioisotope program and the long-range prospects for their investments; the other type is organized for a fast money return with minimum investment and to establish a basis for obtaining government contracts. We believe that we should help the first type of business as much as we can and do as little as possible for the second type. We do not believe that we have any basic disagreement with the Commission's general policy of promoting strong private participation in the production, distribution and utilization of isotopes; however, the secondary supplier organizations as they exist today have been built around ORNL as a basic supplier, and we have a continuing responsibility to these organizations. The secondary radioisotope distribution industry has been aided by the fact that there is always equal opportunity to purchase isotopes and services from ORNL by any bona fide organization.

The long-range effect of forcing ORNL out of the primary supply business would be to reduce the probability that new organizations could enter the field. This would interfere with the normal competitive forces that are necessary to the operation of a free market and open the door for foreign competition. We strongly urge you to consider the possibility of establishing a clear policy of making ORNL products and services available with minimum restrictions to all bona fide secondary suppliers, AEC facilities, or other AEC-approved customers. Thus, as ORNL gradually withdraws its retail-type services from the general public, the Isotopes Development Center will continue as a strong, reliable, primary source of supply in which the secondary suppliers can have confidence, and monopolies on certain kinds of radioisotopes will not be built up. We believe that such a policy would stimulate the utilization of isotopes and reduce the continual "griping" and charges of unfair competition against the Commission's isotopes distribution program.

Very truly yours,

A. F. Rupp
Director
Isotopes Development Center

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TECHNICAL OPERATIONS
Burlington, Massachusetts

December 21, 1962

Dr. Glenn Seaborg, Chairman
U.S. Atomic Energy Commission
Washington 25, D. C.

Dear Dr. Seaborg:

Our company, among other things, manufactures industrial isotope radiography equipment and encapsulates radioactive sources, primarily cobalt 60 and iridium 192, for use in this equipment. We pioneered the extensive use of iridium 192 in field radiography starting in 1953 and it accounts for the bulk of our isotope sales. We believe we are one of the largest suppliers of this encapsulated material in the United States.

Over the years, we have had the usual problems in dealing with one orm or another of the AEC but on balance each issue has been satisfactorily resolved and our business has prospered and grown. However, a recent action of the Commission has resulted in a situation which gives us cause for concern and prompts this letter.

The successful commercialization of iridium radiography in competition with portable x-ray machines depends critically on the ability to minimize exposure times through the use of physically small, high strength sources; hence only the highest specific activity material is useful. The 75 day half-life of the isotope demands irradiation fluxes of at least 2×10^{14} n/cm^2/sec to fulfill this requirement and 6 or 7×10^{14} n/cm^2/sec is much preferred. The latter flux is a necessity if iridium use is to be greatly expanded from present levels.

Until the end of 1960, all our irradiations were accomplished through rental of reactor space in the MTR at Arco, Idaho and fluxes of 6 or 7×10^{14} n/cm^2/sec were often available to us. Since that time, however, we have been forbidden entry into any government owned reactor of adequate flux level on the basis that General Electric and Westinghouse would provide such service. Westinghouse has since gone out of this business and we are left with access to but one usable reactor in the entire United States, and of course, the AECL reactor at Chalk River. Our concern at this arrangement is severalfold:

1) While the cooperation of both can be commended to date, neither the G.E. nor the AECL reactor can routinely provide us with more than about 2×10^{14} n/cm^2/sec and most of the time give us less.

2) G.E. is one of the largest manufacturers and marketers of industrial radiography equipment in the United States and, as such, is one of our strongest competitors. This equipment, to be sure, is presently x-ray rather than isotope powered but there is a significant area of overlap where either approach may be used; we neither have nor expect any assurance that at any moment we will not find G.E. aggressively in the isotope radiography business as well.

3) AECL is also a direct competitor of ours, extensively in Canada and somewhat less so in the United States. They also want to sell us curies rather than reactor space.

Perhaps you can understand the uneasiness we feel when the very foundation of our isotope business rests so directly on our competitor's policies.

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In addition, I wonder if it is a wise course of action for our government in effect to support the monopoly position of a single company in the provision of reactor space at high flux levels, particularly when that company has a vested interest in many of the applications of the output of that reactor. As long as a really free competitive market does not exist for providing such services should not the AEC reconsider making space available in the government owned MTR, ETR or other high flux facilities. I also suspect continuation of the existing policy will encourage use of non-U.S. high flux reactors rather than the magnificient in-being capacity available within the AEC

I would be pleased to explore this matter further with you in whatever manner you feel appropriate.

Sincerely,

Marvin Schorr

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TRACERLAB

1601 Trapelo Road - Waltham 54, Massachusetts

December 17, 1962

Dr. Glenn Seaborg
Chairman, Atomic Energy Commission
Washington 25, D. C.

Dear Dr. Seaborg:

Tracerlab, a Division of Laboratory for Electronics, has recently given some attention to the Commission's manufacturing, pricing, and promotion of radioisotopes. The following constitutes some of the topics discussed and several recommendations.

I. Manufacturing and Pricing.

We have observed, in the last several years, that a considerable portion of the isotope market has been captured by foreign manufacturers. While assuming that the Commission's technology is second to none, it has become evident that other governments must be underwriting a portion of their respective programs, such that the Commission and several commercial sources of isotopes have considerable difficulty in remaining competitive.

We therefore recommend some modifications in the Commission's Full Cost Recovery Program in order to stimulate purchases from domestic suppliers.

II. Research and Development Support.

In line with the encouragement of isotope usage, we recommend a significant increase in the number of Research and Development contracts designed to assist the solving of industry-wide problems. Too much emphasis has been placed on paper surveys in the past, and, hence, the time lag between idea conception and practical utilization has been much too long.

We therefore recommend the sponsoring of in-plant applications in order to expedite such developments.

III. Confidence in the Commission.

A. Current Users.
   1. Service. The Oak Ridge operation must furnish an efficient, responsive service. The situation has improved somewhat over the former monopolistic mode of operation, but continued improvement is necessary.
   2. Regulations. Our people feel that there has been considerable over-regulation in regard to the licensing and policing of by-product material. Inspection teams in the past have been inconsistent in their interpretation of the regulations.

B. Potential Users.
   1. Licensing. The neophyte is quite often awed by the AEC-313 application form and is frequently discouraged from further pursuit. We recommend that some portion of each AEC symposium be devoted to licensing qualifications. The AEC licensing form could perhaps contain reference to Commission employees who can provide assistance in the completion of the form. Removal of the awesome aura should provide an effective stimulus for the increased usage of radioisotopes.

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2. Regulations. A more realistic approach to regulation should definitely encourage the potential user.

3. Education. We likewise encourage a closer affiliation with wish established technical societies, e.g., the American Chemical Society, by providing speakers and exhibits at their national meetings.

IV. Industrial Liaison.

The first contact between the neophyte and radiation is frequently an industrial company such as Tracerlab. We have the obligation to disseminate current, correct information regarding the Commission's policy on licensing, etc., but frequently find it necessary to interpret Commission policies. The solution may be the creation of an industrial advisory board which could result in a new era of cooperation between the Commission and primary and secondary suppliers.

These comments are submitted in this spirit, and Tracerlab looks forward to a period of constructive growth of radioisotope application.

Very truly yours,

TRACERLAB, A DIVISION OF LABORATORY FOR ELECTRONICS INC.

Richard C. Sorensen, President

RCS-TS:RN

cc Mr. J. L. Salladin, Director of Marketing
Dr. P. C. Abersold, Director of Dept. of Isotope Development, AEC

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UNION CARBIDE NUCLEAR COMPANY

P.O. Box 324, Tuxedo, New York

Research Center

December 4, 1962

Dr. P. C. Aebersold
Division of Isotopes Development
Atomic Energy Commission
Washington 25, D. C.

Dear Dr. Aebersold:

During the past week at the American Nuclear Society meeting in Washington, Mr. D. B. Holzgraf and Mr. G. W. Leddicotte had some conversations with Mr. John Maddox and Mr. Gene Fowler about our activities in the production of radioactive isotopes. It became apparent that we had entered the business of producing isotopes so quietly that your Division was not aware of our efforts. Because of a meeting to be held on December 10, 1962, Mr. Fowler asked if we could describe to your office our present activities. These activities are at present not very large but we are actively reviewing the isotope markets and our production capabilities to see how they might fit into the Union Carbide Corporation's activities in nuclear energy. We would hope to be able to review our conclusions with you and Mr. Tremmel when we have finished our study.

At the present time we are producing several radioisotopes for sale to Squibb, a Division of Olin Mathieson, New Brunswich, New Jersey, and to Iso/Serve, Inc., Cambridge, Mass. This letter summarizes the present status of such work:

Production of Radioisotopes

Iodine-131 - We are routinely producing 5 curies of I-131 whenever required. The iodine is made by irradiating high purity tellurium dioxide and processing in a hot cell to separate the product iodine from the bulk TeO_2. 400 millicuries of I-131 is being sold weekly. Our present price is $0.20/millicurie.

Phosphorus-32 - This material is made by irradiating high purity sulfur and processing in a hot cell to separate P-32 from the sulfur. 400 millicuries will be sold bi-weekly beginning December 17, 1962. Our present price is $0.75/millicurie.

Iridium-192 - 4 curies per month is sold. The iridium is in the form of 4,000 individual needles, each containing 1 millicurie.

Gold-198 - 100 curies per week is sold.

Sodium-24 - 60 millicuries is sold weekly.
Potassium-42 - 400 millicuries per week is sold.
Bromine-82 - 50 millicuries is sold bi-weekly.
Copper-64 - 50 millicuries is sold bi-weekly.

Suitable salts containing the above material are placed in individual capsules but all of the capsules are irradiated in one container.

Mercury-197 - 300 millicuries of Hg-197 is sold bi-weekly.

Service Irradiations

Price schedules have been established for service irradiations in both the reactor and cobalt-60 facilities. Eleven companies or universities have used our facilities since March, 1962. A list for our charges for facilities is attached.

Advertisements

Advertisements concerning the nuclear facility and service irradiations have appeared in Nucleonics, Science, Chemical and Engineering News and Cosmetic and Drug Reporter.

Very truly yours,
UNION CARBIDE NUCLEAR COMPANY - J. C. Brantley, Director of Research

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UNITED STATES RADIUM CORPORATION
P.O. Box 246
Morristown, New Jersey

November 14, 1962

Mr. John N. Maddox, Technical Assistant to the Director
Division of Isotopes Development
United States Atomic Energy Commission
Washington 25, D. C.

Dear Mr. Maddox:

Some weeks ago, during a conversation with you, you mentioned that the Commission would be interested in any information we might be able to submit relative to the effect of price of tritium on demand for luminous products activated by tritium. This cannot be estimated with any degree of accuracy but reference to a few projects on which we are now either actively working or negotiating may give some rough idea.

1. The clock and watch industry, assuming the introduction of tritium compounds simply maintains the status quo, can require well in excess of 100,000 curies per year. This program is starting slowly due to confusion on the part of the clock and watch manufacturers and the need, on the part of the dial luminizers, to develop efficient and economical application techniques. One other major deterrent, however, is the price of the compound compared to the price of radium activated compounds. For equivalent brightness the price is approximately double that of radium materials and tritium represents 50 to 75 per cent of the cost. Any price reduction in tritium would improve this price situation and stimulate this program.

2. We are currently producing, for the Canadian Government, a quantity of 5000 to 6000 special luminous survey meter dials. Each of these uses tritium compound in the amount of $4.00 to $5.00, of which tritium represents about two thirds of the cost. Canadian Civil Defense, we know, is interested in 10,000 to 20,000 similar dials but must acquire them at a reduction of several dollars in unit price. U. S. manufacturers are also interested at a price comparable to that requested by Canadian Civil Defense. Tritium at 50% the present price would stimulate interest in this and comparable programs since such a price reduction, when one considers with it overhead, isotope loss, duties and markup, represents several dollars in unit cost.

3. We have recently quoted on two jobs where tritium offers excellent possibilities and any substitute method of lighting is relatively inefficient. The price differential between tritium luminous compounds and conventional lighting is holding up a decision.

   a. In case 1., the project involves 100,000 parts, 70,000 of which require 1 to 1-1/2 curies each, and the other 30,000 pieces, perhaps 200 to 500 millicuries each. Present price differential between conventional and tritium illumination is about 1 to 3 and the customer is undecided. Tritium at $1.00 per curie would make the ratio about 1 to 2 or less and probably decide the issue.

Appendix "B"

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b. In case 2., we have quoted on 10,000 parts. Each requiring 4.6 curies of tritium. Finished unit price is $23.00 and we are competing against a less reliable but usable system at perhaps $12.00 to $15.00. We feel sure that narrowing this gap by $4.00 to $5.00 would resolve the customer's indecision.

4. Commercial aircraft emergency exit markers, now specified by the F.A.A., should require a total of perhaps 10,000 curies as gas. Indications are that when installation of these is effected, the airlines, or many of them, will wish to extend the program to include many markers not covered in the F.A.A. specification, provided price is not prohibitive.

The above are typical of applications under development or now starting into production and we have not included items covered in Research and Development projects now in progress or completed for the Air Force, Frankford Arsenal, the Navy and others. In general, the price of tritium is a factor of considerable importance in commercial applications and of lesser importance in military applications. The current $2.00 per curie price for tritium does double the price which the customer is accustomed to paying for luminous compounds and even the price for radium compounds has always been one of the deterents to larger scale use.

We would appreciate the comments of the Commission regarding the possibility of a price reduction and the feasibility of establishing a sliding scale of prices related to quantity purchased. It would also be appreciated if an indication of price could be given for firm orders for say, 25,000, 50,000, 75,000 and 100,000 curies for delivery over a fixed period of perhaps one year. Should such a program be feasible to the Commission, would it also be permissible for U. S. Radium and Radium-Chemie, with whom U. S. Radium is cooperating in developing tritium compounds to pool annual requirements into a single firm commitment? Assuming that an attractive price could be offered, we would possibly make an immediate commitment for 30,000 to 50,000 curies or more.

Your comments on the above will be appreciated.

Very truly yours,

C. W. Wallhausen
Vice President

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APPENDIX "C"

CHRONOLOGY OF EVENTS RELATED TO AEC-INDUSTRY

PARTICIPATION IN RADIOISOTOPE PRODUCTION AND RELATED SERVICES

1946 First public distribution of reactor-produced radioisotopes.

1948 Production and distribution of radioisotope labeled compounds by commercial firms.

1954 AEC withdraws from fabrication of sources for radioisotope gages.

1955 AEC completely withdraws from film badge service.

1955 AEC completes withdrawal from labeled compound business.

1955 AEC withdraws from processing and distribution of cyclotron-produced radioisotopes.

1958 AEC withdraws from providing encapsulation of Co-60 sources for the public.

1960 AEC withdraws from sale of Polonium 210 sources of less than 20 curies.

1960 AEC discontinues providing standard reactor irradiated units.

1960 First private production and marketing of Iodine 131.

1960 First private production of Cobalt 60.

1961 AEC withdraws from routine Cobalt 60 production.

1961 AEC withdraws as a supplier of plutonium-beryllium neutron sources for private use.

1961 First private production and marketing of short-lived radioisotopes.

1962 AEC withdraws from providing neutron activation analysis service.

1962 AEC withdraws from fabrication and sale of Polonium 210 sources less than 1000 curies for private use.

1963 AEC withdraws from supplying encapsulated Iridium 192 sources.

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APPENDIX "D"

RADIOISOTOPES CURRENTLY AVAILABLE FROM OR CONTEMPLATED FOR COMMERCIAL PRODUCTION IN PRIVATE REACTORS

No.	Radioisotope	Company	Half-life	Start of Production
1.	Antimony-124	Western Y.Y.	60 days	Began production late 1962
2.	Bromine-82	Western N.Y.	36 hours	Began production early 1962
		Union Carbide, New York		Began production in 1961
		Iso/Serve Inc.		Began production in 1960.
3.	Cadmium-115	Western N.Y.	53 hours	Unknown
4.	Calcium-45	GE	164 days	To consider production in 1963
5.	Calcium-47	Iso/Serve	4.7 days	Started production early 1962.
6.	Carbon-14	GE	5,760 years	To begin production late 1963 or early 1964.
7.	Chlorine-36	GE	320,000 years	To consider production in 1963.
8.	Chromium-51	GE	27.8 days	Plan to start production spring 1963.
9.	Cobalt-60	GE	5.27 years	Started production in 1959.
10.	Copper-64	Western N.Y.	12.8 hours	Started production early 1962.
		Iso/Serve		Started production in 1962.
11.	Fluorine-18	Western N.Y.	1.87 hours	Started production late 1962.
12.	Germanium-77	Western N.Y.	12 hours	Started production late 1962.
13.	Gold-198	GE	65 hours	May start production in 1963.
		Union Carbide, New York		Started production in 1962.
14.	Hydrogen-3 (Tritium)	GE	12.46 years	Plan to start production late 1963 or early 1964.
15.	Iodine-125	CE	57.4 days	Plan to start production spring of 1963.
		NSEC		Started production mid-1961.
16.	Iodine-130	Iso/Serve	12.5 hours	Began 1961.
17.	Iodine-131	GE	8.05 days	Began December, 1962 (no evidence to date).
		Union Carbide, New York		Began production 1962.
		Abbott		Began production 1960.

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No.	Radioisotope	Company	Half-life	Start of Production
18.	Iridium-192	Union Carbide New York	74.5 days	Started production late 1962.
		GE		Started production late 1960.
19.	Iron-55	GE	2.94 days	To consider production in 1963.
20.	Iron-59	GE	45.1 days	Plan to have available spring 1963.
21.	Mananese-54	GE	314 days	To consider production in 1963.
22.	Mercury-197	Union Carbide, New York	Hg^{197} Hg^{197m_2} 65 days	Supplying some low specific activity material late 1962.
23.	Mercury-203	GE	45.8 days	Plan to have available spring 1963.
24.	Molybdenum-99	GE	67 hours	To consider production in 1963.
25.	Nickel-63	GE	125 years	Consider production in 1963.
26.	Phosphorus-32	Western N.Y.	14.3 days	Started small production 1962.
		Union Carbide, New York		Started production Dec., 1962.
		GE		Planned to start production September 1962 (no evidence of sales).
27.	Potassium-42	Western N.Y.	12.7 hours	Unknown
		Union Carbide, New York		Began production 1962.
		Iso/Serve		Began production 1961.
28.	Rubidium-86	Western N.Y.	18.6 days	Unknown
29.	Sodium-24	Union Carbide, New York	15.0 hours	Began production 1962.
		Western N.Y.		Unknown
		Iso/Serve		Began production 1961.
30.	Sulfur-35	GE	87.1 days	To consider production in 1963.
31.	Thallium-204	GE	4.1 years	To consider production in 1963.
32.	Thulium-170	GE	127 days	Started production 1961.
33.	Zinc-65	GE	245 days	To consider production in 1963.

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APPENDIX "E"

RADIOISOTOPES PRODUCED AND DISTRIBUTED BY AEC AND ABBREVIATED PROFIT AND LOSS STATEMENTS

RADIOISOTOPES PRODUCED AND DISTRIBUTED	FY 1962 REVENUES
I. Inventoriable Items and Major Products	
Carbon 14	$ 232,840
Cerium 137*	207,048
Cobalt 60	125,991
Promethium 147*	5,466
Technetium 99*	24,024
Krypton 85	60,675
Chlorine 36	12,532
Thallium 204	15,723
Strontium 90*	1,246,427
Tritium	59,810
Cerium 144	176
Zirconium 95-Niobium 95	3,379
Iodine 131	46,349
Iridium 192	37,827
Phosphorus 32	106,632
Bromine 82	2,816
Calcium 45	14,989
Calcium 47	36,321
Copper 64	10,458
Gold 198	20,556
Iron 59	68,425
Potassium 42	13,600
Sodium 24	10,750
Sulfur 35	27,675
Chromium 51	40,688
II. Minor Products	
Antimony 122	25
Antimony 124	1,011
Antimony 125	4,088
Argon 37	217
Argon 38	325
Arsenic 76	190
Arsenic 77	75
Barium 131	117
Barium 133	8,917
Barium 140 - Lanthanum 140	4,611
Bismuth 210	1,170
Cadmium 109	2,747
Cadmium 115 m	1,737
Cadmium 115	72
Calcium 45 P-2	1,715
Calcium 45 P-3	16,401
Cerium 141	488
Cesium 134	797
Cobalt 58	3,130
Europium 152 - 154	932
Fission Products	719
Fluorine 18	100
Gallium 72	116
Gold 199	731
Hafnium 181	126
Helium 3	N.A.
Indium 114m - 114	390
Iodine 125	14,890
Iodine 129	3,033
Iodine 130	259
Iodine 132	3,790
Iodine 133	60

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Iridium-194	0
Iron 55 - 59	1,067
Iron 55	11,853
Lanthanum 140	619
Mercury-197m - 197	104
Mercury 203	8,589
Molybdenum 99	12,936
Neodymium 147 - Promethium 147	600
Nickel 63	26,151
Niobium 95	2,320
Osmium 191	31
Palladium 109	58
Phosphorus 32 P-2	5,488
...	
Praseodymium 142	195
Praseodymium 143	300
Rhenium 186	57
Rubidium 86	2,293
Ruthenium 97	5
Ruthenium 103	1,029
Ruthenium 106 - Rhodium 106	3,385
Samarium 153	508
Scandium 46	3,472
Selenium 75	476
Silver 110m - 110	320
Silver 111	1,013
Strontium 85	34,085
Strontium 89	5,539
Tantalum 182	166
Technetium 99m	1,430
Tellurium 132	220
Thulium 170	1,036
Tin 113	
Tungsten 185	468
Tungsten 187	60
Xenon 133	41,563
Yttrium 90	246
Yttrium 91	5,374
Zinc 65	2,766

III. Special Services

Service Irradiations

86" Cyclotron	73,478
Graphite Reactor	18,853
LITR	7,650
ORR	30,262
Cobalt 60 Gamma Facility	596
Fuel Element Gamma Service	10

Services

Activation Analyses	11,675
Target Fabrication	1,075
Cesium 137 Source Fabrication	51,379
Tritium Targets	15,804

* Major fission product

N.A. Not available

PROFIT AND LOSS STATEMENTS FOR

ORNL PRODUCTION AND DISTRIBUTION PROGRAM

	FY 1958	FY 1959	FY 1960	FY 1961	FY 1962*	FY 1963 (est.)
Radioisotope Sales	$2,368,466	$2,421,500	$2,449,969	$2,248,243	$3,421,051	$2,328,000
Less Cost of Goods Sold - Fund and Nonfund Cost	2,475,233	2,367,416	2,209,584	2,242,328	3,789,603	2,536,000
Profit (Loss)	(106,767)	54,084	240,385	5,915	(368,552)	(208,000)
AEC 15% Factor	371,285	355,112	331,438	336,349	568,440	336,000
Profit (Loss) Including AEC 15% Factor	(478,052)	(301,028)	(91,053)	(330,434)	(936,992)	(544,000)

Notes: 1. Sales and cost of sales data from ORNL financial statements.

2. Sales and cost of sales amounts include intro-AEC and other Federal Agency transactions, research discounts, special services and packing and handling.

* Includes $1,315,028 of Strontium 90 and Cesium 137 for SNAP program.

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APPENDIX "F"

COMPARISON OF PRICES

FOR SOME CYCLOTRON

PRODUCED RADIOISOTOPES

	Oak Ridge National Laboratory - 1955	Nuclear Science and Engineering Corporation - 1962	Abbott Laboratories - 1962
Arsenic-73	$75/mc		1st mc $28.50 to 20 mc $423.50
Beryllium-7	$40/mc	$75/mc	
Cobalt-57	$75/mc	$75/mc	1 - 9 mc $75/mc 10 - 24 mc $70/mc 25 - 99 mc $60/mc
Manganese 52-54	$175/mc	$200/mc	
Sodium-22	$100/mc	$330/mc	$350/mc
Strontium-85	$150/mc	$200/mc	
Zinc-65	$100/mc	$100/mc	

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APPENDIX "G"

OAK RIDGE NATIONAL LABORATORY

Oak Ridge, Tennessee

November 26, 1962

Mr. E. E. Fowler
Deputy Director
Division of Isotopes Development
U. S. Atomic Energy Commission
Washington 25, D. C.

Dear Gene:

Subject; THE CYCLOTRON RADIOISOTOPE PROGRAM

Attached is a paper in which the case for processing cyclotron targets by ORNL is given.

For many years the unique 86-inch cyclotron was used principally as a research tool, and the parts of the cyclotron required mainly for radioisotope production were not maintained in good condition, since they were not required for the research effort and money was always short. In addition, there was no strong desire to improve the machine to give increased beam time. Equipment changes and modifications are now necessary to get the machine in good condition to produce cyclotron radioisotopes that cannot be produced in reasonable amounts elsewhere in the United States. The cost of such changes is an expense item which should be offset by sales income from additional business. We do not believe that the income would be increased merely by an increase in the beam-hour charges. An over-all growth similar to that developed for reactor-produced radioisotopes is needed.

We hope that the attached paper will assist you in securing approval for the processing of cyclotron targets, which is the first step in promoting the usage of cyclotron radioisotopes.

Sincerely yours,

A. F. Rupp
Director
Isotopes Development Center

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THE CASE FOR PROCESSING CYCLOTRON RADIOISOTOPES AT ORNL

November 26, 1962

Current regulations permit cyclotron targets to be bombarded in the ORNL 86-inch proton cyclotron for private and commercial customers, but the targets cannot be processed to separate, purify and assay the contained radioisotopes except for local research work. The reason for this regulation is said to be that the distribution of processed cyclotron radioisotopes by ORNL would constitute unfair competition with established privately-financed industry. However, processed, pure, assayed, reactor-produced radioisotopes have long been distributed by the Laboratory, to the almost universal satisfaction of the scientific community and the apparent approval of most of the commercial radioisotope processors and distributors. The question arises: "Why should cyclotron radioisotopes be singled out for application of such restrictive measures?" There appear to be no good reasons in the affirmative, but many in the negative; these are given in the following discussion.

(1) Production of Larger Batches is More Efficient and Economical.

In many cases where there are orders from several customers for a cyclotron radioisotope, it can be produced more economically by a single, large-scale long bombardment than by several small target bombardments. It is estimated that the unit cost in a one-hour bombardment is three to seven times as much as in a ten-hour bombardment.

(2) Small Customer-type Target Bombardments Result in Waste of Valuable Radioisotopes.

Even from a minimal-type target bombardment, the customer often gets more activity than he can use. By processing various kinds of targets at the Laboratory--large and small--solutions of radioisotopes could be maintained in inventory (at the Laboratory or by a distributor) to quickly satisfy the needs of many users.

(3) Processing Will Result in Lower Costs to Customers and Greater Income to Support Cyclotron Operations.

Because of economies in operation, the costs of cyclotron radioisotopes would go down. Furthermore, it would not be necessary for the customer to purchase more than he needs. Even if distribution is made by commercial laboratories from ORNL bulk shipments, economies should be realized by the users. It is also of importance that radiation exposure to our personnel is reduced when fewer hot targets are handled.

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(4) Shipping Charges Could Be Reduced.

The customer would pay less for shipping processed solutions in the highly efficient ORNL non-returnable containers than for shipping cyclotron targets in large-cavity containers. Gas targets are already handled this way because there is no safe shipping container yet developed for gaseous cyclotron targets.

(5) Efficient, Economical Use of Enriched Target Materials.

Targets that contain enriched stable isotopes are not used efficiently when sold as unprocessed targets. Small amounts of enriched materials are often contaminated by inexperienced radiochemists; and if they are returned for reworking, the cost is high for intermittent special rework. Enriched materials could be quickly recovered by ORNL, which has the necessary facilities and know-how. This would make enriched materials more readily available for re-bombardment, and the customers could avoid the large losses incurred in discarding enriched target materials.

The following is a list of Enriched Isotopes that are used for cyclotron bombardments.

Isotope	% Enrichment Usually Used	Cost/Mg	Usual Cost of Isotope per Target
Ag-107	99.6	$ 0.60	$ 18.00
Er-168	76.9	0.80	24.00
Eu-151	92.1	1.00	30.00
Eu-153	94.8	1.00	30.00
Gd-152	36.2	65.00	325.00
Nd-146	96.2	1.20	36.00
Nd-148	92.9	3.50	105.00
Ni-64	95.9	16.50	330.00
Sb-123	98.1	2.50	75.00
Sm-147	89.7	1.25	37.50
Sm-148	96.3	1.75	52.50
Sm-149	97.5	1.50	45.00
Sm-150	96.4	2.75	82.50
Sr-84	34.1	10.00	5,000.00
Te-123	48.58	10.75	450.00
Te-124	76.47	3.50	350.00
Te-126	95.4	0.70	21.00
Yb-171	93.8	0.80	24.00
Yb-172	95.9	0.65	19.50
Yb-174	98.4	0.45	19.50

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(6) Definite Bombardment Schedules Would Result in Better Services and Lower Decay Loss for the Customer.

A great deal of decay loss is incurred on short-lived cyclotron isotopes because of the cumbersome target shipping; heavy containers for targets must go by slow or expensive transport, and delays are encountered in handling and processing at the user's site. Most users are not equipped for fast processing and analysis. Since definite schedules for bombardment and processing can be established by ORNL and the customer, decay losses could be minimized. Basic researchers often need special fast service with processed materials for studies of nuclear energy levels, etc. In the case of the short-lived cyclotron radioisotopes, it is difficult to see a useful role for the commercial distributor at all. The following list gives some short-lived cyclotron radioisotopes of interest.

Isotope	Half-Life*
Sc-44m	2.44 d
Mn-52	5.55 d
Co-61	1.65 h
Zn-72	49.0 h
Br-77	58.0 h
Y-87	80.0 h
Tc-95	20.0 h
I-123	13.0 h
I-124	4.5 d
I-130	12.5 h
Cs-132	6.5 d
Ce-135	22.0 h
Ce-137m	34.5 h
Ce-137	8.8 h
Pm-150	2.7 h
Tm-165	29.0 h
Lu-172	6.7 d
Pt-191	3.0 d
Pb-203	52.0 h

*Half-life values from
Trilinear Chart of Nuclides.

(7) Cyclotron Radioisotope Development in the United States Needs a Healthy Production Program in the (National) Isotopes Development Center to Really Make Progress.

The following is a list of processors and/or distributors of cyclotron radioisotopes at the present time.

Nuclear Science and Engineering Corporation,
Pittsburgh, Pennsylvania.

Abbott Laboratories, Oak Ridge - Chicago

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United Kingdom Atomic Energy Authority, Amersham.

Iso/Serve, Cambridge, Massachusetts.

TracerLab, Boston, Massachusetts.

U. S. Nuclear Corporation, Burbank, California.

N. V. Philips-Duphar, Netherlands.

With the exception of Philips-Duphar, none of these organizations has a cyclotron. Most machines to which they have access are university machines of low current capacity. Their primary interest and motivation is in selling isotopes to earn a profit--which is, of course, perfectly proper. However, the vast, important area of neutron-deficient isotopes and other species peculiar to cyclotron production will not be explored and really put into its proper position in the world of science if the job is left entirely to these poorly-motivated organizations.

The large-scale, vigorous, integrated approach which was employed by ORNL to put the reactor-produced radioisotopes, fission products, and enriched isotopes on the map of the scientific world is needed if this program is ever to go forward. We envision the time when not one, but several cyclotrons will be operating at ORNL to make available this valuable, relatively untouched group of radioisotopes. We should be thinking of versatile, high-production machines (the counterpart of the HFIR) for the future.