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| Atomic Energy Project | 1954-1960 |
| NOTES | |
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9 June 1954

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Mr. James M. Miller
Assistant to the Vice-President
Business Affairs
University of California
Berkeley 4, California

BEST COPY AVAILABLE

Dear Mr. Miller:

A number of the items raised in your letter of 4 June 1954 have been brought to the attention of the Regents twice last year, and have been approved by them in principle. The reason for desiring to appear once more before the Regents and their committees is due to the increased cost of the reactor building by approximately \$200,000. The reasons for this increase were described in detail in the 13 May 1954 letter to President Sproul. However, we are pleased to make point by point comments or answers to statements or questions put by you in order to help clarify the entire matter. Your paragraphing notation is used. It might be well to state at this time that the proposed nuclear reactor is a multi-functioned unit that could be expected to have an important teaching function, in addition to the experimental medical research that is being planned. It is suitable for teaching graduate students and engineers concerning reactor theory and operation. It is unlikely that it would become obsolescent in the foreseeable future even if other reactors are built in this area. This is partly due to the fact that the design of this particular reactor permits a teaching function, as well as medical and other types of research. A similar situation exists with respect to the cyclotron on this campus, which has been kept quite busy for a number of years even with other larger cyclotrons in the state.

- 1) See letter from Mr. Robinson, Treasurer of CICR. There is no conflict between the terms of the CICR gift and the ultimate use of the reactor as presented to the Regents.
- 2-a) In order to evaluate the adequacy of our financial plan for operation for a reasonable time a breakdown of estimated costs and estimated income will be made. First it should be stated that a number of members of the Department of Radiology will be available as consultants, at no charge to the Reactor Program, to assist in the planning, organization, and to some extent in the execution of the work. This category includes Drs. Dowdy, Greenfield, Bennett, Libby, and others, all of the Radiology Department. Also included are two assistant professors who will be funded as line items of the Radiology Department in 1955-56. These two men are needed by the Department whether there will or will not be a nuclear reactor program. They will contribute a portion of their time, as consultants without charge to the Reactor Program, in the areas of isotope production and some of the radiation research work.

The following is a statement of the estimated cost to the University for operating the reactor and for carrying out the necessary research work to thoroughly calibrate the reactor and to do the necessary biological animal work prior to use for humans.

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| For operation of the reactor | (1. Asst. Research Physicist (Reactor Physicist) | \$6,000. |
| | (2. Jr. Research Physicist (Reactor Physicist) | 4,980. |
| | (3. Secretary-Stenographer | 3,060. |
| | (4. Supplies and Expense | <u>1,944.</u> |
| | Sub-total | \$15,984. |
| For physical calibration of reactor & biological dosimetry prior to use for humans & for radioisotope production | (5. Asst. Research Physicist, for physical dosimetry and calibration | 6,000. |
| | (6. Asst. Research Chemist, for research in production and use of radioisotopes and chemical control of reactor | 6,000. |
| | (7. Asst. Research Biophysicist, for biological dosimetry and related work | 6,000. |
| | (8. Supplies, equipment, including animals, phantom materials, ionisation chambers | 2,516. |
| | (9. Travel | <u>1,000.</u> |
| | Sub-total | \$21,516. |
| | | \$15,984. |
| | | plus <u>21,516.</u> |
| | Grand Total | \$37,500. |

From the above the minimum cost of operation of the reactor is estimated as \$15,984 per annum. This includes only items for the safe and proper operation, as well as maintenance of the reactor. The additional cost of the research program is \$21,516. This latter sum will result in measurement of the thermal and fast neutron fluxes, as well as the gamma ray intensities of the beams withdrawn from the reactor. Additionally, measurements will be made of the thermal flux available in various locations inside the reactor and the performance of the reactor with regard to production of radioisotopes. The research program will also result in various measurements of the effects of reactor radiations on animals so that the eventual safe use for humans will be assured. Reports will be written describing the results of the above research and will, in effect, constitute the return for the expenditure of the grand total of \$37,500.

Two years of operation at the above level is guaranteed by the Atomic Energy Commission. In their 15 April 1954 letter they state that continued use of the reactor may be reasonably anticipated beyond the first two years despite the fact that no legal commitment beyond two years can be made at the present time. Additional grants are expected from other governmental agencies such as the Air Force (a request to submit a proposal has been received by the Air Force) and the U. S. Public Health Service. After the reactor has been thoroughly proven for use in connection with medical therapy, it is anticipated that

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income will be derived from patients receiving treatment at the reactor, as well as from the sale of radioisotopes and irradiation services.

- 2-b) No conflict exists between the dedication to treatment of human patients desired by the Atomic Energy Commission and the performance of cancer experimental work and treatment desired by OIGR since these are equivalent aims, stated in different words. There is also no conflict between desires of the Atomic Energy Commission and the ultimate use of the reactor. The Atomic Energy Commission has been thoroughly briefed on all aspects of our proposal, and recognition of this fact as well as implied approval is contained in the last paragraph of their 15 April 1954 letter.
- 2-c) The technical staff of the Radiology Department has already had much experience in the handling of radioisotopes, familiarity with the necessary safety provisions described in various regulations promulgated by the National Bureau of Standards (e.g., Handbook 41) and even with an identical type of nuclear reactor. Thus there is no problem in connection with complying with the Atomic Energy Act and the requirements of the Atomic Energy Commission that is not familiar to the staff. The Radiology Department will assume responsibility for compliance with all necessary requirements.
- 2-d) The limit of one kilogram of U235 not only will not impose any hardship on the reactor program, but is the limit desired for technical reasons by the staff of the Department. The fuel is to be lent to the University by the Atomic Energy Commission and remains the property of the Atomic Energy Commission. This is a matter between these two entities. It is for that reason that North American Aviation does not become involved in obtaining the fuel for the University. The Atomic Energy Commission has indicated in national publicity that the U235 will be lent to suitable centers for suitable research purposes. The extent to which the Atomic Energy Commission has already proceeded in negotiations with us indicates that they regard UCLA as a suitable center.
- 3) It should be understood that the radiations to be protected against are basically not different in their effects from those produced by cyclotrons, synchrotrons, or even by x-ray machines. In all cases one must comply with known (to us) standards of protection as put forth by the National Bureau of Standards. What differs in these various examples is the cost of providing the appropriate protection. The problem of insurance is not different here from what is needed for any device capable of producing ionizing radiation.
- 4) The statement is correct. A detailed analysis of the operation costs for the first two years is given in item 2-a).
- 5) As shown in item 2-a) the operating cost is expected to be a total of \$37,500 per annum to be paid by the Atomic Energy Commission. It

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would be well to restate at this point that the Atomic Energy Commission is willing to pay \$37,500 per annum for a two-year period because they are very interested in having the reactor calibrated and all radiations measured, both from a physical and from a biological point of view. This involves using both physical instruments such as ionization chambers and biological entities (mice, rats, rabbits, dogs, etc.). The reports that will be written describing all such work will be what the Atomic Energy Commission obtains for its expenditure. After this initial calibration work the Atomic Energy Commission is interested in using the reactor with its known and calibrated radiations to obtain the information it would like to have. It is for these reasons that we expect the Atomic Energy Commission's continued support for operation funds for the reactor. The expected net profit will arise from the fact that the reactor is a multi-functioned device. In other words, one can make isotopes at the same time one is doing an animal research experiment, or one can irradiate food or other bulk items at the same time the previous two activities are going on. These collateral activities require little additional expenditure of personnel and materials and, therefore, represent potential sources of profit. In connection with food irradiations it would only be necessary to place the food in position and to withdraw it at appropriate times. The preparation of chemicals and subsequent handling of the radioisotopes would be done in part by interested members of the Department who wish to use some of these isotopes in their research. It might be necessary, if the volume of isotope production and sales warrant it, to hire a technician specifically for this purpose, working under the supervision of an Assistant Professor of the Department. The following is a detailed estimate of possible income and expense in connection with sale of isotopes and irradiation time.

The following estimates of reactor income from sale of radioisotopes are based on current Oak Ridge prices and shipping charges. After an initial trial period such fees would have to be worked out by us on the basis of actual experience. Our actual charges could conceivably be less or more or the same as the prices quoted below:

Estimated Income

A. For medical uses.

- (1) K^{42} (potassium). Half-life is 12.4 hours; currently used at Wadsworth Hospital, V.A., to study metabolism of muscular dystrophy. One unit costs \$12 plus the shipping cost of \$70. Assume one sale per week at only the shipping cost of \$3,500.
- (2) Na^{24} (sodium). Half-life is 14.9 hours; useful for studying electrolyte changes in heart disease. Costs like that for K^{42} . Assume one sale per week of \$3,500.
- (3) Cl^{38} (chlorine). Half-life is 37 minutes; useful for cardiac fluid studies; completely unavailable from Oak Ridge because of very short half-life. Estimated annual sale based on one sale per week of \$1,000.

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B. Industrial uses.

- (1) Br⁸² (bromine). Half-life is 35.5 hours; useful for studying halogen reactions in petroleum. Shipping costs similar to Rn²²², Na²⁴. Estimated annual sales, if on a once a week basis of \$2,500.
- (2) As⁷⁶ (arsenic). Half-life is 26.8 hours; useful for studying insecticides. Estimated annual sales of \$2,500.
- (3) Cu⁶⁴ (copper). Half-life is 12.9 hours; metallurgical applications. Estimated annual sales of \$2,500.
- (4) Au¹⁹⁸ (gold). Half-life is 2.7 days; metallurgical and medical applications. Estimated annual sales of \$1,000.
- (5) P³² (phosphorus). Half-life is 14 days; fertilizer research. Estimated annual sales of \$1,000.
- (6) Cl³⁸ (chlorine). Half-life is 37 minutes; useful in polyvinyl plastic industry. Estimated annual sales of \$1,000.

G. Food Sterilization.

Preliminary discussions with Quartermaster Corps indicate that if we had the reactor now they would have a need for radiation exposures of rather fantastic amounts. Discussion concerned income of up to \$100,000 per annum for several years. Taking a small fraction of this, say 10% - estimated annual income of \$10,000.

TOTAL INCOME \$28,500.

Estimated Expenses for Isotope Production and Irradiation Exposures

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| (1) Senior Laboratory Technician | \$3,700. |
| (2) Laboratory Technician | 3,200. |
| (3) Materials and Supplies, including chemicals, glassware | <u>1,500.</u> |
| Total | <u>\$8,400.</u> |

Estimated Net Profit - \$28,500.
less 8,400.

\$20,100.

This net profit of approximately \$20,000 per annum would be used for amortisation of the additional \$200,000 building fund referred to previously.

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The estimates of potential isotope sales are based in part on the interest regarding the isotope sales market in California shown by such well known isotope distributors as Tracerlab, the Abbott Company, and others. We have received communications regarding these matters from these companies.

It should be emphasized that there is a unique character about most of the isotopes listed above. Since most of them have rather short half-lives they are either unavailable (e.g., chlorine 38) or lowered considerably in radioactive strength by virtue of the transit time required to get them from other centers in the United States. Often they are made in larger quantities to compensate for the decay, necessitating rather heavy lead shielding to protect against the high initial strength. Thus this often results in virtually paying for shipping lead across the country, and paying relatively little for the isotope itself. By contrast local manufacture avoids these problems and for a period of at least two years, and possibly longer, our reactor would have a monopoly in the production and distribution of short-lived isotopes.

- 6) Since the building and the reactor are integrally connected and inseparable, they must perforce be constructed at the same time. Any plan to withhold construction of the building until the reactor is built is technically not possible and is unknown to us.
- 7-a) Preliminary approval was obtained last year. Final approval by this Committee will be sought some time this summer.
- 7-b) It is our understanding that this Committee would have interest only in the human use of radioisotopes produced and not in the reactor or any of its activities other than the above; approval for use of a number of radioisotopes is already on hand.
- 7-c, d) The proposal has been discussed with the University Physician and his Supervisor for the Division of Radiological Safety, Mr. Nelson Garden, who has given verbal approval of the preliminary plans. It is intended to continue consultations with all appropriate University authorities.
- 8) North American Aviation's statement is the usual one comparable to the disclaimer that a manufacturer of x-ray equipment might make. In no case can such manufacturers be responsible for the actions of our staff or our technicians. The responsibility for the proper use of the reactor equipment is the same responsibility that the Department of Radiology already has for the proper use of x-ray units. Additionally, North American Aviation will be responsible for their own personnel who may be connected with the 240-hour training program.
- 9) The necessary permits needed from the Federal authorities are those needed from the Atomic Energy Commission itself. As is implied by their

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15 April 1954 letter, they have corresponded with us on these matters and are prepared to formalize these permits when actual negotiations are under way. There are no specific requirements by the county or state authorities, as far as I know, other than to comply with Atomic Energy Commission regulations. I checked with North American Aviation and they have been operating a similar type water boiler reactor for over two years. They have never been required to satisfy any specific county or state requirements, but simply the Federal regulations.

- 10) No objections to the suggestion made. Title for the reactor will remain within the University. The Regents have been twice informed of North American's role in connection with the reactor and that the sales price is approximately \$100,000 below North American's cost. This latter sum then is a gift from North American Aviation. The Regents are aware of this. Since this generous offer expires on 29 June 1954, competitive bidding would not seem appropriate. The approval of the President and the Board should certainly be obtained for the name plate designation proposed by CICR.
- 11) It should be noted in the last paragraph of the April 15, 1954 letter from the AEC that they acknowledge that most, if not all, of the terms and conditions in their letter have been touched on and need only to be formalized. Specifically a proposal should go forward and contain the following:
 - a) A description of our financial plan for building the reactor should go forward; see documentation items (1), (2), (3), (4) in 13 May 1954 letter to President Sproul for this material. Our operational plan as described in item (2a) of this letter should also be sent.
 - b) Competence of technical personnel for design and operation documented by item VIII of "Special Project, Dept. of Radiology, UCLA Medical Center, June 1953" sent President Sproul and the Regents. Further evidence of competence of designers at NAA indicated by their successfully building two water boilers similar to the one proposed for us. This material should be forwarded.
 - c) Documented by item IX and X of report referred to in (b) above and also
 - d) They are stating the conditions of the loan of the U²³⁵ which we are in a position to comply with. This is so because our staff members are already experienced in handling radioisotopes, have some experience with water boilers, know the AEC regulations with regard to safety, currently practice these regulations in our present laboratories, and are familiar with accountability and security regulations of the AEC.

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- e) This item can be guaranteed as being possible; i.e. the Atomic Energy Project at UCLA will have all the reactor time needed for their work.
- 1) It is agreed that the AEP at UCLA will have reactor time available for a programmatic cost-type contract.
- 2) Stipulation accepted as being quite satisfactory.
- 3) Balance of reactor cost assured by documentation mentioned in (a) above. Construction of building can only be assured if Regents act favorably in this matter. Our plans are to annex such building to the hospital in the new medical center at UCLA campus, satisfying their stipulation on this point.
- 4) The one kilogram limit of U-235 is more than ample for our entire needs and is a satisfactory stipulation.
- 5) This is a reasonable stipulation and implies inspection after completion of the reactor.

Very sincerely,

M.A. Greenfield, Ph.D
Associate Professor and
Radiation Physicist

Approved:

Andrew H. Dowdy, M.D.
Professor of Radiology and
Chairman of the Department

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Enclosure: Letter Robert Robinson to Dean Warren, June 1954

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