May 18, 1951

Dr. Allan Lough
Isotopes Division
U.S. Atomic Energy Commission
Oak Ridge, Tennessee

Dear Dr. Lough,

We are submitting herewith Form 313 for 8.8 curies of Sr-90, to be delivered at the rate of 500 millicuries per week upon notification. We expect to use the material in the preparation of beta ray sources to provide excitation for the phosphor unit in "Type F" metascopes.

The anticipated schedule will require the production of at least 1000 units per week. We expect to produce them in accordance with our standard procedure for the manufacture of radioactive foils with certain modifications to provide shielding and remote handling facilities as required. Each unit will consist of a silver-gold bimetallic disc approximately .5 inch in diameter by .006 inch thick, containing 224 microcuries of Sr-90. Since the discs will be blanked from rolled strips, approximately 60 per cent of the original active material is recovered in the final product; and the rest is considered unavoidable blanking waste.

The various steps involved in the preparation of the units may be broadly classified as follows:

1. Receiving, checking and aliquoting Sr-90 solution.
2. Precipitation on gold powder
3. Filtration and drying

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4. Mixing

5. Compacting

6. Sintering and rolling

7. Weighing and welding

8. Rolling of final foil

9. Blanking

10. Assembly on foil mounting

11. Final instrument assembly

The material is received in an isolated anteroom adjacent to the main plant where the shipping container is opened and the active material is transferred to a wooden carrying case having sufficient wall thickness to absorb all beta radiation. The operation is carried out over a plastic tray, using a long pair of tongs, and the operation is monitored by means of a SU-1b radiation meter.

After transfer to the laboratory the carrying case is placed in a tray under the hood, and operating through a port in a one-half inch lucite shield, the bottle is conveyed to a lucite box. By menas of a remote control pipetting arrangement, a small aliquot of the solution is applied to a polystyrene disc and evaporated to dryness for an activity measurement.

Present consideration of the project anticipates the preparation of the foils of such size that 100 MC increments of Sr-90 will be used. On this basis each compact will contain 2.5 grams of gold powder, and 100 MC of Sr-90 precipitated as the carbonate with sufficient added Sr carrier to account for about 4 per cent of the total weight. A weighed amount of gold powder is placed under water in a small beaker which also contains the added carrier and sufficient NaOH to neutralize the acid in the active solution. The Sr-90 solution is added by means of a remotely controlled pipette, and precipitation is effected by the addition of an excess of sodium carbonate solution.

Using a tared, fine porosity, fritted glass crucible, the Sr-90 gold mixture is filtered and

washed. The line from the suction flask will lead through a sulfuric acid bath and glass wool trap to the vacuum pump. The crucible containing the mixture is heated at 110°C for 1 hour and weighed. Handling of the crucible is to be accomplished by means of boxes constructed from lucite of sufficient thickness to absorb all beta radiation. These boxes will be open on one side and provided with a hole in the other by means of which the crucible can be manipulated using a spring operated gripper. The balance is a Fisher Gramatic provided with additional shielding in front. This technique has been tried on a small scale in the handling of luminous inserts and has been found satisfactory. The filtrates will be retained and evaporated for disposal.

While the technique of precipitating the active material in the presence of the gold powder provides some degree of homogeneity, the uniformity desired in the final product requires further mixing. This is normally accomplished in the case of radium by hand mixing using a boron carbide mortar and pestle. This operation is made possible by the fact that the step is completed soon after the radium has been de-emanated and before the beta and gamma radiation levels have increased appreciably. In the case of Sr-90, however, it is necessary to provide a mechanical device for the operation, since the beta radiation levels will be very high. Test apparatus under construction at this time consists of a stainless steel cylinder rounded at the bottom and provided with a tapered top, which is attached to the bottom part by means of an external threaded collar and a ground and lapped joint. The cylinder will be equipped with a number of hardened steel balls, and mixing will be accomplished by rolling the cylinder at an angle on glass blowers rollers.

After mixing the powder will be delivered through the tapered top into the recess of a compacting die. This die consists of a rectangular opening in a piece of tool steel which is equipped with two removable plugs. The entire assembly is made from hardened and polished steel and the plugs fit with clearances of 0.0005 inch on all sides. In preparation for filling the bottom plug is fitted into place and covered with a piece of precisely cut gold foil 0.001 inch thick. Next

the powder mixture is delivered as described above and after leveling is covered with a piece of gold foil. The top plug is carefully fitted into place and a pressure of 20 tons per square inch is applied. The die is placed on a steel ring and the bottom plug and compact are ejected. The compact is removed from the press into one of the previously described lucite boxes. The dry operations of the last two steps will be carried out in a dry box by means of shielded tongs.

The compact is placed on a ceramic block and sintered in a muffle furnace by heating for ½ hour at 1500°F. Then by alternately rolling and annealing the thickness of the briquette is gradually reduced from 0.050 to about 0.0025 inch. The unit is weighed and a factor giving the concentration of Sr-90 in microcuries per milligram of foil is computed.

Preparatory to welding the compact foil will be cut into four approximately equal pieces by means of a shielded "Di-Acro" shear equipped with a micrometer feed attachment. After the weight is determined the compact foil is centered on a block of silver 0.150 inch thick, which rests on mica in the bed of a stainless steel die. A block of stainless steel is placed over the top and the gold and silver are welded together by the application of pressure after heating to 1000°F.

The final rolling is accomplished by repeatedly passing the silver-gold bimetal through the rolls with gradual closing until the foil has reached precalculated dimensions which give the concentration desired. In this case the final product will consist of an active area 2.5 x 10 inches at a Sr-90 concentration of 1 MC per square inch. The overall thickness of the foil will be in the order of 0.006 inch and the thickness of the active layer will be about 2.5 microns.

The blanking operation will be carried out by feeding the foil through a shielded tunnel into a gang die, which will blank 5 discs per cycle. The discs will fall through the die into a shielded receptacle. The scrap foil will be received in a special container and retained for eventual recovery of the gold and silver or for disposal.

The assembled unit which fits into the instrument is a semi-circular bail equipped with a flat disc at the center of the arc which serves as a mounting for the foil. In mounting the foil the face of the holder will be tinned and fastened in a jig. The foil will be set in place by means of a vacuum handling tool and sweat-soldered down with a heated fixture which will be piston operated and have a smooth surface conforming to the shape of the foil mounting. After soldering the units will be placed in containers for delivery to the final assembly line.

Assembly into the instrument will be carried out by means of a special device which compresses the ends of the bail just sufficiently to allow them to engage the pins. This will be shielded with lucite to protect the hands of the operator, and the operation will be carried out behind a lucite barrier equipped with ports. After insertion of the foil, the instrument is closed and is considered safe to handle from this point on.

We hope that this description is sufficiently detailed to enable you to visualize the process. It is our belief that by following the techniques outlined and carefully monitoring the various steps, any difficulties arising from radiation may be avoided.

I believe Mr. Wallhausen has discussed the urgency of this project with you. Your best efforts to expedite authorization for the procurement of the isotope will be very much appreciated. I shall be glad to supply any other information you consider necessary.

Very truly yours

UNITED STATES RADIUM CORP.

C. C. Carroll
Chief Chemist

CCC:ml
cc :CWWallhausen