



NATIONAL AERONAUTICS AND SPACE ADMINISTRATION  
LEWIS RESEARCH CENTER  
CLEVELAND, OHIO 44135



REPLY TO  
ATTN OF:

December 26, 1974

Antonio R. Antunez, M.D.  
Cleveland Clinic Foundation  
9500 Euclid Ave  
Cleveland, OH 44106

Dear Dr. Antunez:

In compliance with your request of December 22, I am enclosing a brief progress report on the cyclotron beamline intended for fast neutron therapy. In addition two possible vertical beam arrangements are shown. These would use two existing magnets, a 22 degree and a 118 degree, that we are not using in our system and are available. One possibility is to have a vertical beam in the beam room in which we will have the horizontal fast neutron beam; the second possibility is to make the vertical beam in an area we call the skylight area and in which Mr. Stickney shows a patient reception room in his proposal. There are three rough drawings enclosed to show these possible vertical beam facilities.

Enclosed you will find an abstract from a paper in Cancer which I am sure will interest you. Since we do not have that journal here at Lewis, I would appreciate your sending me a copy of this paper.

Sincerely,

James W. Blue

attach - Fig 1 Sketch of area (horizontal plan)  
Fig 2 Vertical section to beam room  
Fig 3 Vertical section to skylight  
Fig 4 Hammersmith Abstract

## Progress report on Lewis Cyclotron fast neutron beam facility Dec.1974

The cyclotron beam line is completed to the extent that we have had beam through the magnets M-1, M-2, M-3, shown on Figure 1 and the system of focussing magnets F-1, F-2, and F-3. This beam was used to bombard a neutron producing target located at the point marked T on Figure 1. We have made some preliminary measurements of the neutron spectrum from this target using threshold activation techniques. We plan in the near future to use the Cleveland Clinic's photo-densitometer-computer system to determine the beam profile at various depths in polyethylene. The next problem will be to determine the dose rates using tissue equivalent ion chambers and then the fraction of this dose due to neutrons and that due to gamma radiation.

The preliminary design of the Naval Research Laboratory collimator of steel and borated polyethylene which is to be located in the beam room is complete. The detailed design is not complete and the steel required for the collimator has not been ordered. This assembly will not be ready before April 1, 1974.

## Considerations of a vertical beam facility at the Lewis Cyclotron

We have considered the possibility of using two existing beam magnets which are capable of bending the cyclotron beam 22 degrees and 118 degrees in order to make the cyclotron beam vertical. This arrangement would provide for a vertical neutron beam so that a patient could be in a horizontal position.

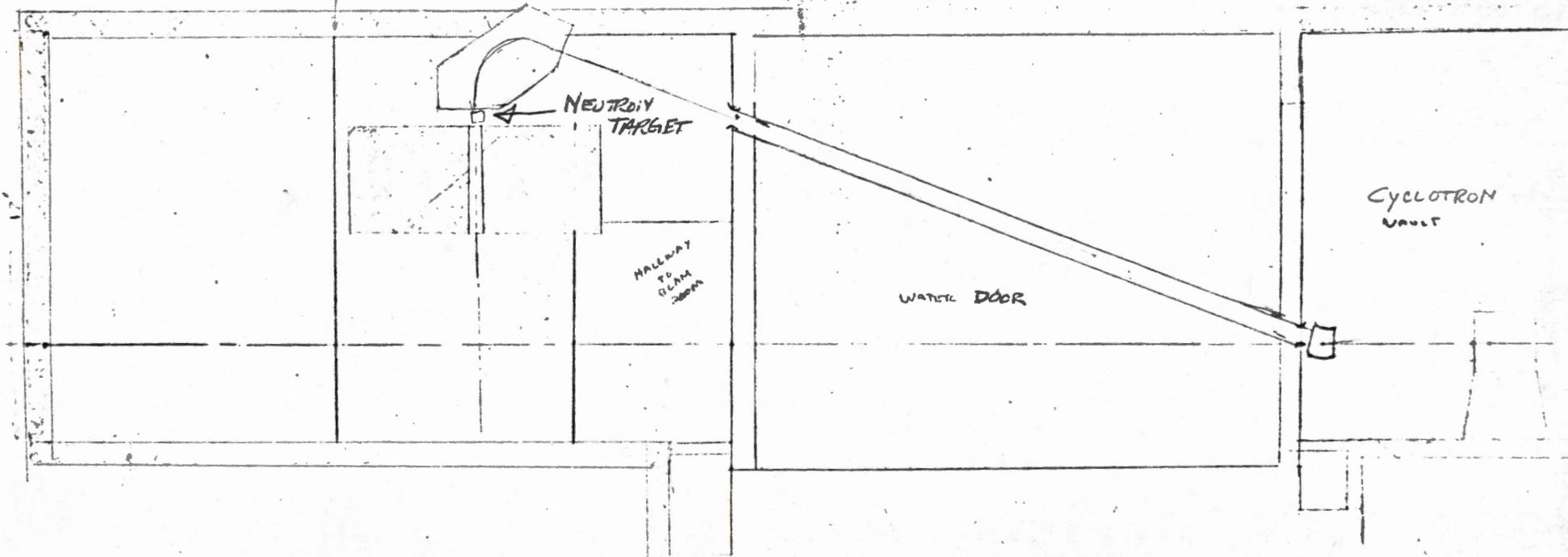
One possibility would be to put the 22 degree bending magnet in position A in Figure #1 and bend the beam through the 4 foot roof of the beam room to a small room that would have to be constructed above our existing beam room ceiling. In this room we would locate the 118 degree bending magnet. Figure 2 shows a vertical section of this beam line. The position of the horizontal beam does not have to be as shown in figure 2 because the neutron producing target and collimator assembly can be moved further into the room. The vertical and horizontal beams could be made isocentric.

The second possibility would be to place the 22 degree magnet in front of the water door (position B on Figure 1) and bend the beam upwards to the 118 degree magnet located in the skylight area. This would provide another area for neutron therapy but would require a massive shield below the 118 degree magnet which is not required in the first arrangement wherein the target is high enough so that 4 foot concrete ceiling of the beam room provides shielding.

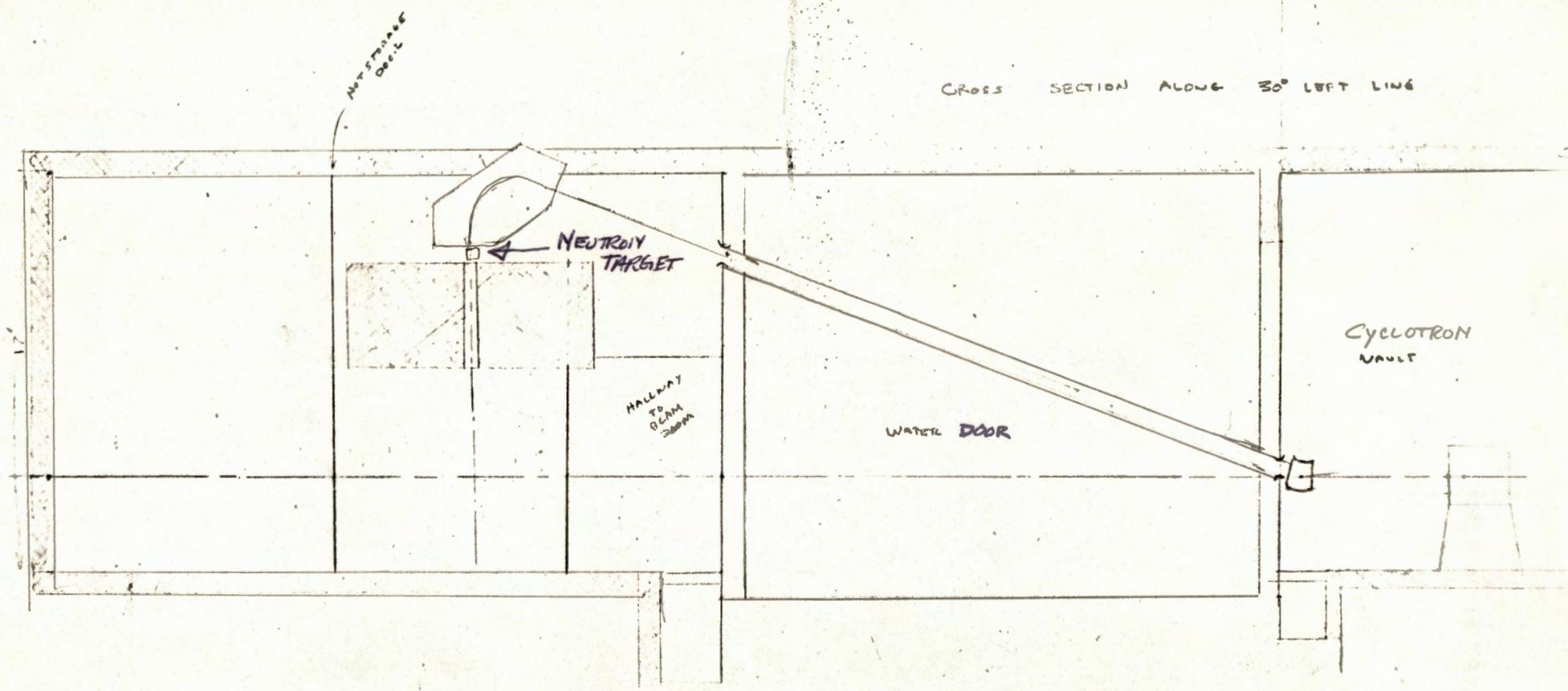
Neither of these arrangements has received any kind of engineering costing study but to give you some idea of the cost I would guess that either arrangement would end up costing about \$35,000.

HIT PASSAGE  
CHAMBER

CROSS SECTION ALONG 30° LEFT LINE



VERTICAL SECTION OF BEAM TO SKYLIGHT AREA



VERTICAL SECTION OF BEAM TO SKYLIGHT AREA