

EXTERNAL FOCUSING EQUIPMENT

FOR

60-INCH CYCLOTRON

Contract: NA3-545
G-E Reqn: CL-193000

February 28, 1956

EXHIBIT

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EXTERNAL FOCUSING EQUIPMENT FOR 60-INCH CYCLOTRON

The following external focusing equipment, building modifications, installation materials and installation will be furnished by General Electric Company to supplement the equipment, materials, and installation furnished on Contract NA3-545, (G-E Requisition CL-193000) covering one 60-inch Cyclotron.

1. EQUIPMENT (See G-E Drawing 103C477)

a. Beam Duct and Accessories

(1) Duct - An evacuated tube will be attached to the cyclotron target chamber, to provide a non-scattering path for the output beam as it passes successively through a set of focusing coils, alignment magnet, objective slit, and deflector to the beam ports. The duct will consist of several sections to facilitate installation and subsequent partial disassembly when it is desired to bombard large targets with the unfocused beam close to the cyclotron. Flexible couplings will be provided at the cyclotron end for alignment of the duct with the emergent beam.

(2) Entrance Aperture - At the entrance to the duct, an aperture plate will be provided to define a sharp beam and reduce the bombardment of the duct walls by the unused portion of the original beam. This plate will be insulated so that its collected current may be measured to monitor the cyclotron performance during a run on a target.

water cooled?

✓ (3) Alignment Magnets - To make final corrections in aiming the focused beam down the duct to align with the center of the deflector, a 4-pole electromagnet will be provided with two pairs of coils energized to allow deflecting the beam in vertical and horizontal directions.

- (4) Objective Slit - An assembly of four shutters will be mounted in quadrature, and will be arranged so that each may be moved radially from a wide-open to a fully-closed position to define a sharp beam area. Each shutter will be insulated to allow measurement of the current intercepted by it. This assembly will serve two functions. First, it may be used to provide a narrow objective slit when using the deflector magnet as an analyzer, and second, it may be used as an indicator of the alignment of the beam by comparing the currents collected in the four quadrants.
- (5) Deflection Chamber - An integral part of the duct mounted between the poles of the deflector magnet. It will be of rectangular cross-section and "Y" shaped, to allow the beam to pass straight through with the magnet de-energized, or to be deflected with the magnet energized. It will include flanges to connect to the circular duct sections preceding and following it.
- (6) Final Duct Sections - These will be larger cross-section to allow for the increased width of the beam due to its divergence after being deflected. These sections will be flanged at the exit end to receive the beam ports.
- (7) Target Plates - Target plates will be attached to the end flanges of the final duct sections to seal off the vacuum. They will be insulated to allow measurement of current reaching them.

b. Focusing Coils

- (1) Coil Assembly - An assembly of two quadrupole assemblies of 2-inch aperture and of the same basic design as that developed at University of California Radiation Laboratory.

- (2) Mounting - The magnets will be mounted on an adjustable base and stand allowing leveling of the assembly, and individual horizontal alignment of each magnet.
- (3) Power Supply - A motor generator set will be provided for power supply with individual control of the current through each magnet.

c. Deflector

- (1) Magnet - The magnet will consist of a Varian, Type V-4012A, 12-inch magnet with special pole tips.
- (2) Mounting - A base will be provided for floor mounting. Adjustments will be provided for initial alignment. Should the beam position move off the center of the deflector with different cyclotron adjustments, it may be moved back with the alignment magnets on the beam duct described in Paragraph a(3).
- (3) Power Supply - This will consist of a Varian, Type V2100 power supply and a V-2101B voltage regulator.

d. Vacuum System -

- (1) Vacuum Pump - A Kinney, Type KC-15 pump having a pumping speed of 5.2 liters per second will be provided. This speed will exceed the pumping speed of the duct, which will be the limiting factor. The duct will be exposed also to the cyclotron vacuum through the entrance aperture providing additional pumping capacity during operation.
- (2) Refrigerated Baffle - A refrigerated baffle will be provided to prevent diffusion of oil back into the cyclotron. Because of the relatively high pressures at which this system will operate (of the order of microns), resulting in a short free path of oil particles in the gas, this baffle will be of special design. A separate refrigeration unit will be provided to cool the baffle.

(3) Accessories - A valve will be provided to isolate the system from the duct, and a thermocouple vacuum gage will be provided to monitor the pressure. The existing gage and interlock on the target chamber of the cyclotron will prevent opening the target chamber gate before the duct is sufficiently pumped down, and also close the gate should a severe leak develop.

2. NEW TARGET ROOM (See G-E Drawing 102D880)

The existing South Wing (N.A.C.A. Drawing CD-103150 et seq.) will be extended to provide a target and equipment room beyond the existing knock-out section in the south wall of Room S-1, and an access corridor from Room S-5.

Heating, lighting, and drainage facilities will be furnished to be connected to existing N.A.C.A. facilities and to provide ventilation by means of blowers with intake from outside air.

The wall between the target room and the cyclotron room (S-1) will be 6 feet thick of standard concrete for radiation shielding. The roof and west wall will be 2 feet 6 inch concrete to shield from scattered radiation through the dry soil above. Floor will be 8 inches thick, since moist soil underneath will absorb scattered radiation from this direction.

3. CONTROL EQUIPMENT

a. Controls and/or instruments will be installed on an auxiliary panel in the present control room for the following:

- (1) Focusing Coils
- (2) Deflector Magnet
- (3) Alignment Magnets
- (4) Beam Alignment Indicator
- (5) Aperture and Target Current Meters
- (6) Beam Duct Vacuum Gage

b. Target Room

out Duplicate controls and/or instruments will be installed on a panel in the target room for the following:

- (1) through (6) - Same as in control room.
- (7) Emergency and Beam-Off Push Buttons

4. INSTALLATION

This proposal includes all materials, labor and supervision required to install and wire the equipment covered in this proposal. The general layout subject to minor revisions as detailed design progresses, is shown in Drawing 103C477.

Additional cable will be installed for the power, control, and metering of this new equipment. Power will be taken from the existing bus. Cable runs between the cyclotron room and the target room will be through conduit running down through the floor near the 6-foot wall, under the wall, and up through the floor in the target room. The double bend is to prevent radiation passing through. Cable runs from the target room to the control room will be on cable racks suspended from the ceiling of the corridors.

After final positioning of the deflector magnet, which determines the position of the final duct sections, the hole in the wall around the duct sections will be filled in with concrete blocks, overlapped to prevent direct radiation leakage. Additional shielding to reduce direct leakage through the ducts or secondary radiation from the concrete structure, ducts, target ports, or other equipment is not included.

The interior of the new target room will be painted and the exterior will be graded and re-sodded.

5. ADJUSTMENTS AND TESTS

In addition to furnishing and installing the additional equipment, this proposal includes the time of experienced scientific personnel for testing and adjusting the additional equipment up to a maximum of forty (40) man-weeks. Within this maximum of forty (40) man-weeks our best efforts will be

exerted, at our discretion and with no warranty as to degree of success, to complete the tests and adjustments of the additional equipment. It is estimated that this forty (40) man-weeks of test and adjustment will be performed in approximately ten (10) weeks by a crew of three (3) General Engineering Laboratory scientists and one (1) engineer/mechanic, with the tests and adjustments to start within four (4) weeks after the completion of installation.

The tests and adjustments which will be undertaken are as follows:

- a. Test and correct, if necessary, the vacuum tightness of the system so that residual leakage is within the capacity of the vacuum pumps.
- b. Test and correct, if necessary, the operation of all controls and added equipment to obtain functional performance of these controls and added equipment.
- c. Obtain sufficient output from the cyclotron to allow alignment of the additional equipment.
- d. Initial adjustment of the beam duct, focusing coils and deflector.

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