EAST CENTRAL DISTRICT

APPARATUS DEPARTMENT

GENERAL ELECTRIC COMPANY

MAIN OFFICE SCHENECTADY, N. Y.

4966 Woodland Ave.
Cleveland 4, Ohio

June 1, 1948

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National Advisory Committee
For Aeronautics
Cleveland Airport
Cleveland, Ohio

Attention: Mr. James R. Braig

Gentlemen:

Mr. John H. Collins, of NACA, during his recent visit to Schenectady, expressed a desire to have in his files a report outlining the policy we are following in designing the 60" cyclotron to be furnished on subject requisition. Such a report follows.

The study of cyclotron design started in the fall of 1945 when it was proposed that a 90" machine be included in the company's own nucleonics program. Dr. G.W. Dunlap of the General Engineering and Consulting Laboratory in collaboration with Research Laboratory and Electronics Department personnel set out to make an analysis of existing designs. Dr. Dunlap had just returned from the University of California Radiation Laboratory where he had been associated with their war-time activities for approximately two years.

Design information was made available in the form of both drawings and descriptive material. This coupled with visits to MIT, Carnegie Institution, University of Rochester, University of California, and University of Illinois resulted in a firm foundation in cyclotron theory, design, and operating practices. The knowledge gained permitted establishment of tentative design requirements for a 90" machine. This was later scaled down to a 70" unit for economic reasons.

At this point the company's cyclotron program was deferred. However, in discussions with such recognized authorities as Prof. E.O. Lawrence it was pointed out to us that there was an urgent need for a source of engineering, design, and manufacture of complete machines. It was felt that in providing such a service we would be making a definite contribution by relieving the research worker of the

cc: Collins
to J R Braig

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task of designing and building his own tools. With this in mind, we continued our studies of existing and new cyclotron developments. These activities included additional visits to cyclotron installations. Several weeks were again spent at Berkely, and short visits made at Washington University, St. Louis, and Chicago University.

With the background gained in the foregoing activities we were confident that we were prepared technically to undertake the design of this type of accelerator. Our survey of company facilities confirmed our opinion that we were in an excellent position to coordinate and manufacture complete equipments. Except for the magnet core and standard vacuum and circulating pumps, we were fully equipped to carry on design and construction entirely within the company's own engineering divisions and shops.

When requested by NACA to submit a bid on a 60" cyclotron, we recognized that the performance specifications which were more rigid than any heretofore established would demand a thorough review of existing design information and considerable pioneering under the guidance of the latest and best thinking on improved treatment of presently known factors affecting attainment of the customer's requirements. To accomplish this to the point of arriving at specific designs prior to submission of our proposal to NACA was impractical both from an economic viewpoint and from the standpoint of time and manpower available. However, with data and experience accumulated over a period of years we were able to arrive at general component requirements and prepare engineering and manufacturing costs. The data and experience accumulated included not only the studies made of cyclotron theory, design, and operating techniques, but actual development, design and manufacture of accelerators, such as Betatrons and Synchrotrons in various sizes comparable in both size and complexity to many of the present operating cyclotrons as well as development design and manufacture of cyclotron components.

Upon learning that NACA had accepted our proposal we immediately started a systematic re-examination of previously accumulated information and concurrently established tentative design requirements of major components. Inasmuch as certain design features differed in varying degree from the traditional, it was only natural that we should seek the comments and advice of those who were working directly with operating machines.

With this in view and our design requirements well in mind we visited Carnegie Institution, Washington, DC; University of California Radiation Laboratory; MIT; UCLA at Los Angeles; Washington University, St. Louis; and Columbia University. At these places we inspected respectively, 60"

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60" and 184" (Synchro); 42"; 37" (Synchro); 45"; and 165" (Synchro under construction) machines. Our tentative component design requirements for the NACA 60" were discussed with the personnel associated with the design, construction, and operation of these machines. The personnel with whom we talked ranged from specialists on particular phases of cyclotron design such as magnetics, r.f., and control thru those familiar with the overall aspects, to the men responsible for the routine operation and maintenance. Many of these were young men who had not been heard of outside their own group but who have established a reputation within that group by their excellent contribution and the spade work they performed in reaching the solution to problems encountered in the design and operation of these machines.

Mention should also be made of a visit to Bethlehem Steel Company's forging and machine shops where all steps in the production of Chicago University's 2000 ton Synchro-cyclotron magnet core were observed.

These visits consumed approximately three weeks and upon our return to Schenectady we were certain that we could proceed with our detail design with confidence. Except for one or two minor revisions in our conception of cyclotron behavior, our tentative design plans and approach had met with approval. This was particularly gratifying considering that our approach in some respects had been to apply sound engineering principles to established cyclotron techniques.

We are now in the process of tying down critical design dimensions and characteristics of various components and transmitting them to the contributing departments responsible for drafting and manufacture. In many cases it was possible to determine the requirements in a relatively short time. In these cases orders were placed on the contributing department shortly after receipt of the requisition to insure the components' early inclusion in engineering and manufacturing schedules.

There follows a list of the people associated with accelerator activities with whom we have discussed cyclotron problems prior to subsequent to acquiring the NACA contract. In many cases the contacts were the result of the other party enlisting our assistance on his particular cyclotron program.

Carnegie Institution - Washington, DC
M.A. Tuve
Dean Cowie
R.B. Roberts
P.H. Abelson
S.J. Buynitzkey

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Columbia University
J.R. Dunning
E.T. Booth

Cornell University
R.R. Wilson (formerly at Harvard)

Iowa State College
G.W. Fox

Los Alamos
Joseph Fowler

M.I.T.
M.S. Livingston
Eric Clarke

McGill University
J.S. Foster

University of California at Berkely
E.O. Lawrence
W.M. Brobeck
R.L. Thornton
J.G. Hamilton
Wilson Powell
Thomas Putnam
K.E. Relf
M.T. Webb

Universityof California at Los Angeles
K.R. MacKenzie)
J.R. Richardson) formerly at Berkely
B.W. Wright)

University of Chicago
S.K. Allison
J. Marshall, Jr.
H.L. Anderson

University of Rochester
S.W. Barnes
G.B. Collins

University of Southern California
C.M. VanAtta

Washington University at St. Louis
F.N. D. Kurie
A.A. Schulke

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England
T.E. Allibone
M.L. Oliphant

Sweden
M. Siegbahm
T. Svedberg
H. Tyren
Borge Helstrom
P.O. Kinell

As our designs progress we expect there will from time to time be a need for further consultation with some of those listed above and this will be done. When designs are finalized it may be desirable to obtain an independent check from some one or more of the individuals listed. The extent of such a check will depend somewhat on how frequently we have consulted during progress of the designs.

Our understanding of the relationship between ourselves and Prof. E.O. Lawrence of the University of California Radiation Laboratory was outlined to Mr. Collins. We pointed out that we were free to consult with Prof. Lawrence and members of his staff at any time. This was not a new arrangement as it has been in operation for several years. However, it was Mr. Collins' desire that some individual, preferably Prof. Lawrence, be designated specifically as our consultant on the design and construction of the 60" cyclotron we are manufacturing for NACA.

Fortunately, a few days after we had the opportunity to review this subject with Prof. Lawrence on one of his periodic visits. In the course of the conversation, Prof. Lawrence not only confirmed our understanding but agreed to act as consultant in a more formal sense. He will, when such action is helpful, review our designs as they progress and also in their final form.

It should be understood by all concerned that Prof. Lawrence is interested solely in the technical aspects of our accelerator activities. He does not want to be included in any publicity.

We trust you will take this as additional assurance that we have availed ourselves of the best sources of information obtainable on cyclotron design and construction.

Yours very truly,

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K F Culler

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Mr. James R. Braig -6- June 1, 1948

P.S.

Dear Mr. Braig:

I would appreciate it very much if you could see to it that in addition to Mr. Collins receiving a copy of this letter, that a copy is sent to Mr. Sharp as I would like very much to have him personally understand we are leaving no stone unturned in trying to develop cyclotron for NACA as it will be the best one ever built by a wide margin.

K.F.C.