MEMORANDUM

Preliminary Proposal
Number 231

BETA TANK FACILITIES

BUILDING 9201-2

OAK RIDGE NATIONAL LABORATORY
operated by
UNION CARBIDE CORPORATION
for the
U.S. ATOMIC ENERGY COMMISSION

Distribution Date: APR 16 1959

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BETA TANK FACILITIES
BUILDING 9201-2

Prepared for Oak Ridge National Laboratory
by
Engineering Division
Y-12 Plant

March 23, 1959

OAK RIDGE NATIONAL LABORATORY
Operated by
UNION CARBIDE NUCLEAR COMPANY
DIVISION OF UNION CARBIDE CORPORATION
OAK RIDGE, TENNESSEE

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BETA TANK FACILITIES

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A. REFERENCE DATA

Letter from Y-12 Plant Superintendent and Deputy Director ORNL to Director Research and Development, subject: "Request for Directive, Preliminary Proposal Number 231, Beta Tank Facilities, Building 9201-2," dated March 23, 1959.

B. GENERAL DESCRIPTION OF PROJECT

In order to provide a versatile research facility in Building 9201-2, the new quarters of the Sherwood Project, it is planned to rework a series of Beta-type tanks. The tanks, similar to those now installed in Building 9204-3, will be moved to the first floor of 9201-2. There will be four independent chambers with vacuum systems and magnetic fields. A power source of one Alpha II cubicle (+35 KV 1.5 ampere; -35 KV .5 ampere) will be installed for each tank. These tanks will also have interconnections of electric power and other utilities.

C. JUSTIFICATION OF BASIC NEED

Much of the basic scientific work involved in the thermonuclear program requires large vacuum chambers with high intensity magnetic fields. Experimental studies, in particular, require duplication of many of the conditions of a thermonuclear plasma-high vacuum, strong magnetic field, and accelerated particles. This is especially true of such studies as sputtering, arc break-up, ion source development, and certain cross-section measurements. At this time, these studies are being made in the Beta tank units in Building 9204-3. The Beta calutrons have proved most valuable in the research, development and testing programs of Project Sherwood. The tanks, originally used for uranium separation, are mass spectrometers consisting of vacuum chambers with magnetic fields into which ions can be introduced and accelerated.

The tanks in Building 9204-3 will not be available for thermonuclear work after this summer. The building will be turned over to the Isotopes Division, and the Sherwood Project will be relocated in new quarters in Building 9201-2. The new location will require units for research similar to that which has been carried on before in connection with Project Sherwood. Experience with the Beta units in Building 9204-3 shows the tanks and their associated equipment to be well suited for the work, but also shows that the Alpha II cubicle would provide a more flexible and experimentally useful power supply and control console. Since the units are equally available from present, unused installations, and since they must be moved to 9201-2, reworked and installed, this affords an excellent opportunity to obtain a superior research and development facility by using the Beta tanks with Alpha II cubicles. The total cost will be similar regardless of which combination of cubicles and tanks is used. The tanks in 9201-2 will be of even greater experimental value than the tanks in 9204-3 because of the greater versatility that will be designed into the new installation. Features of the new system will include larger vacuum chambers, more varied sizes of chambers available, and ability to operate the tanks at different field strengths.

It is neither feasible nor possible to perform many of the necessary experiments in the DCX type machines. Experiments such as arc support work are already designed and set up to be conducted in Beta tanks. The original molecular beam break-up work and hollow arc experiments were performed in Beta tanks. Furthermore, the Sherwood Project personnel in Building 9201-2 are familiar with the type of equipment the new installation would provide.

The tanks and cubicles are on hand but must be reworked to provide the kind of research facility needed. The magnetic yokes must also be rebuilt; some of the steel required is on hand.

D. PRELIMINARY SCHEMATIC PLANS

Illustrations of the work are to be seen in Appendix 2.

E. OUTLINE SPECIFICATIONS

The Beta tank facility will consist of four separate vacuum chambers. One chamber will be a standard Beta tank; two of the chambers will each consist of two Beta tanks; and the fourth chamber will be composed of three Beta tanks. These tanks will be arranged along with eight standard Beta coils and the necessary magnet yokes to produce the assembly shown in Appendix 2.

Each set of magnet coils will be connected in parallel and supplied with power from four 7,000 ampere, 12 volt rectifiers which will be connected in series.

Approximately 167 tons of steel will be required for the magnet yoke. Of this amount, approximately 98 tons of steel removed from the magnet track in Building 9201-2 will be reused. The balance of 69 tons will be new steel.

The magnet assembly will be located on the first floor of Building 9201-2 in the area bounded by column lines e and d and 10 and 14. A hatchway 39 feet by 10 feet will be cut in the second floor to permit assembling the magnet with the existing 20 ton overhead cranes in the building. A floor opening approximately 46 feet by 10 feet will be cut on the first floor (elevation 929) and the entire area beneath the opening excavated to bedrock. From data collected in this area, bedrock should be encountered at approximately elevation 914.0. New reinforced concrete footings and columns will be constructed from bedrock for the support of the magnet and tank assembly.

Standard Alpha II type high voltage control cubicles will be used for the high voltage supply to the tanks. These cubicles will be located in the southeast section of the second floor of the building in the area bounded by column lines c and d and 14 and $16\frac{1}{2}$.

The single tank unit and the two double tank units will each be evacuated by two 20-inch oil diffusion pumps. All diffusion pumps will be mounted on standard double 20-inch diffusion pump manifolds. Each set of diffusion pumps will be exhausted by a five horsepower Kinney vacuum pump. One 15 horsepower Kinney vacuum pump will be installed as a roughing vacuum pump for all four of the tanks.

Circulating cooling oil will be supplied to the magnet coils from the existing cooling oil system in the building that presently supplies the 86-inch cyclotron coils. This additional heat load will necessitate a minor amount of rework to the west cooling tower (Building 9409-3) behind Building 9201-2. Circulating cooling water for the high voltage cubicles, tanks and vacuum pumps will be supplied from the demineralized water system now being installed as a part of the Project Sherwood relocation installation.

Model magnet tests have shown that magnetic fields of 10,000, 8,000 and 6,000 gauss will be obtained at the mid-point between the single tank coils, the double tank coils and the triple tank coils, respectively.

In general, the major components for the facility are existing in the Y-12 plant. The following is a list of the existing items that will be utilized.

a. Magnet

8 Beta type coils, copper windings, steel core
98 tons yoke steel

b. Coil Supply

16 7,000 ampere, 12 volt rectifiers
16 induction voltage regulators
16 magnetic contractors, size 5, 5,600 volt

c. Vacuum System

10 20-inch oil diffusion pumps complete with six inch auxiliary diffusion pumps
5 20-inch double diffusing pump manifolds with 20-inch gate valves

c. Vacuum System (Contd)

1 15 horsepower Kinney vacuum pump

5 five horsepower Kinney vacuum pumps

8 Beta vacuum tanks; seven of these tanks will be modified to obtain the double and triple vacuum tanks.

d. High Voltage Supply

4 Alpha II type high voltage control cubicles

8 "K" rectifiers

F. SUMMARY COST ESTIMATE

	UCNC Participation	CPFF Contractor Participation	Total
Engineering Design and Inspection	$ 8,000	$ -0-	$ 8,000
Direct Costs	595,000	115,000	710,000
Indirect Costs	14,000	23,000	37,000
Allowance for Contingencies	9,000	14,000	23,000
Gross Total	$ 626,000	$ 152,000	$ 778,000
Items not Requiring Expenditure of Funds			- 528,000
Net Total			$ 250,000

Funds are available in Activity 4900 to cover the cost of $250,000, which is considered capital equipment on the basis of being significant betterment of existing equipment.

G. PROPOSED STARTING AND COMPLETION DATES

This installation is tentatively scheduled as shown below. The dates are contingent upon receipt of directive authorization by April 10, 1959.

	Start	Complete
Engineering Design	April 10, 1959	August 30, 1959
UCNC Field Work	April 15, 1959	July 31, 1959
CPFF Field Work	April 15, 1959	October 31, 1959

H. METHOD OF ACCOMPLISHMENT

It is proposed that UCNC furnish all architect-engineering services including design and inspection. In addition, UCNC should rehabilitate all vacuum pumps, high voltage cubicles, and other existing equipment and provide necessary machine shop services to modify the vacuum tanks. The installation of this facility should be made by a cost-type prime contractor. Because of the job complexity and the integration of the work with other construction in the area, it is not considered feasible to employ a fixed-price contractor.

APPENDIX 1

COST INFORMATION

ENGINEERING COST ESTIMATE

Preliminary Proposal Number 231

I. UCNC Participation

	Material	Labor	Total
Engineering Design and Inspection	$ -0-	$ 8,000	$ 8,000
Direct Costs			
Equipment	528,000	-0-	
Equipment Rehabilitation	2,000	6,000	
Equipment Modification	5,000	40,000	
Yoke Steel	14,000	-0-	
Subtotal	$ 549,000	$ 46,000	$ 595,000
Indirect Costs			14,000
Allowance for Contingencies			9,000
Gross Total UCNC			$ 626,000
Transfer Value of Equipment			-528,000
Net Total UCNC			$ 98,000

II. CPFF Participation

Direct Construction Costs			
Magnet Foundations	$ 5,400	$ 14,500	
Magnet Assembly	4,300	30,000	
Vacuum System	5,800	10,500	
Electrical Work	19,500	25,000	
Subtotal	$ 35,000	$ 80,000	$ 115,000
Indirect Costs			23,000
Allowance for Contingencies			14,000
Total CPFF Participation			$ 152,000

III. Grand Total Project

$ 250,000

The following list is a breakdown of the cost of the existing equipment that will be installed as a part of the new facility.

Item		Unit Cost	Net Cost
8	Beta Coils	$ 18,750	$ 150,000
8	Beta Tanks	4,500	34,000
4	high voltage cubicles	42,500	170,000
16	7,000 ampere rectifiers	7,000 (est.)	112,000
16	induction voltage regulators	500	8,000
8	"K" rectifiers	1,150	9,200
8	"J" rectifiers	1,400	11,200
5	20-inch diffusion pump manifolds	2,444	12,200
10	20-inch diffusion pumps	920	9,200
5	five horsepower Kinney pumps	920	4,600
1	15 horsepower Kinney pump	2,000	2,000
98	tons steel	57	5,600
TOTAL VALUE			$ 528,000

The prices listed are the prices of the equipment new in 1945. Current depreciated (net book) prices are not available.

APPENDIX 2

ILLUSTRATIONS

Plant North

9764

E-60000

9202

9205

9208

E-60500

BITUMIN DRIVE

CARBIDE DRIVE

"C" ROAD

9401-1

9723-4

9723-5

FIRST STREET

9728

9723-6

N-29500

SECOND STREET

9201-2

10 Magnet & Tank Assembly Grade 929.00

14

17

F

High Voltage Cubicle Grade 949.00

D

B

A

1

23

Q

"C" ROAD

9201-3

0 25' 50' 100

SCALE

N-29000

BETA TANK FACILITY
Y-12 PLANT BUILDING 9201-2
PLOT PLAN
PRELIMINARY PROPOSAL
NUMBER 231

D.W. Platz 3-59