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PRELIMINARY PROPOSAL

ELECTROLYSIS DEVELOPMENT FACILITY

FOR

HYDRISIDE COMPONENT RECOVERY

MOUND LABORATORY

OPERATED BY

MONSANTO CHEMICAL COMPANY

MIAMISBURG, OHIO

PRELIMINARY PROPOSAL

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PRELIMINARY PROPOSAL: ELECTROLYSIS DEVELOPMENT FACILITY FOR HYDRISIDE COMPONENT RECOVERY - MOUND LABORATORY

A. Reference Data

This subproject is identified as "Electrolysis Development Facility for Hydriside Component Recovery" and constitutes a specified component of "General Plant Projects - Mound Laboratory" carrying the Budget Project No. 3-241-4605 (B).

This preliminary proposal is submitted as part of the Request for Directive No. 105.

B. General Description of Project

This project covers the design and installation of six (6) experimental electrolysis cells and related equipment in Room 111 of the "R" Building at Mound Laboratory. These cells will be used to develop engineering design data for high capacity electrolysis cells for the separation of Hydrogen, Deuterium and Tritium mixtures. Each cell will be approximately six inches inside diameter and four inches high. The complete system will be installed on the existing floor. No building modifications will be required. Major equipment consists of the six electrolysis cells and burners in a gas-tight system, hoods, power supplies and their controls, temperature recorder and controllers, and a refrigeration system for condensing and drying purposes.

C. Justification of Basic Need

A survey of several methods for recovery of tritium in the hydriside work was authorized in a letter from Dr. John H. Roberson to Dr. J. J. Burbage of November 30, 1953. This survey culminated in a meeting at the New York Operations Office attended by Manson Benedict, Karl Cohen, Jacob Bigeleisen, B. B. McInteer and Russell Leed

in addition to Monsanto and Dayton A.E.C. representatives. The recommendations concurred in at this meeting were summarized in a letter dated January 15, 1954 from Dr. J. J. Burbage to Dr. John H. Roberson on "Status of Work in Thermonuclear Component Fabrication" (54-1-65). This letter states in part: " ---- Studies of thermal diffusion, electrolysis, and low temperature distillation methods indicate that sufficient technical information and design data do not now exist to permit a rational choice of method or to allow design of a facility of sufficient capacity for the recycle phase of the hydrizide program". It recommends that a thermal column be installed to handle initial recovery material from the preparation and fabrication areas, and that " ----- a development program be started to gain technical information upon which a choice of method can be made and to develop engineering design data on high capacity thermal columns, electrolysis cells, and low-temperature stills. It is important to recognize that the development phase will help insure the construction of a reliable full-scale recovery plant by July, 1957".

A letter from Dr. John H. Roberson to Mr. S. R. Sapirie dated January 19, 1954, subject: "Thermonuclear Component Fabrication at Mound" (54-1-71) states in part:

"We would like to proceed immediately on installation of an electrolysis development facility and a thermal diffusion development facility ----. These are to be kept as separate capital projects and will be described in separate preliminary proposals. There are sufficient funds in Mound General Plant Projects for FY 1954 to cover the estimated cost so that these can be authorized when requested.

I am asking Monsanto to proceed with the preparation of the preliminary proposals for the thermal column installation and for the two development facilities."

This write-up is the second of three preliminary proposals and directive requests submitted in accord with the aforementioned request of Dr. Roberson.

A major consideration in determining the magnitude of the recovery phase is the determination as to whether the hydriside material can be recycled without isotopic purification. Realistically speaking, recycling without purification could not continue indefinitely without requiring an isotopic separation, so the ability to recycle would only delay the time when a full scale recovery unit would be required. Efforts will be made to recycle hydriside without isotopic separation; however, because of the uncertainty of being able to do this and the ultimate need for an isotopic separation facility, long range planning necessitates the inclusion of a high capacity isotopic separation plant.

In addition to the need for an electrolysis development program to establish design data for large scale production recovery units another need exists for this program in that electrolysis cells will be required as a head end process step to change materials that are in the liquid state to the gaseous state for feed to thermal diffusion columns used for recovery. Estimates show that at least half of the process wastes originating from the preparation and fabrication lines in the "T" Building that contain recoverable material are in the liquid form and will require processing in electrolysis cells before going to these thermal columns. It is possible to greatly

increase the capacity of these columns by designing cells which will yield high separation factors during the electrolysis operation. Electrolysis development is required to determine engineering design data for such cells.

For the electrolysis development facility six experimental electrolysis cells are necessary to obtain data for proper choice and design of large scale production cells. It is planned to first set up a one-cell unit, then a two-cell unit, and finally a three-cell unit. The general purpose of this electrolysis system will be:

1. To serve to familiarize personnel with handling and operating techniques for this type of equipment.
2. To determine feasibility of operation with regard to health physics considerations.
3. To determine feasibility of continuous maintenance-free operation of this type of process.
4. To establish separation factor data on ternary mixtures of hydrogen-deuterium-tritium.

Data are available on hydrogen-deuterium mixtures and hydrogen-tritium mixtures, but none is known on ternary mixtures of hydrogen-deuterium-tritium.

A brief description of the electrolysis units follows:

One-cell unit - this cell is of approximately two to four liters in volume, six inches inside diameter, four inches inside height, is water cooled, its out-gas is connected to a burner, and has a capacity of approximately ten to fifty liters of hydrogen per hour. It will handle hydrogen-deuterium mixtures, and its specific purpose is:

1. To check out the performance of the cell, burner, and auxiliary equipment designed for this specific purpose.

2. To familiarize personnel with operating and handling techniques.

Two-cell unit - each of these in series with burners, will be approximately the same size and capacity as the one-cell unit with modifications. The cells will be made of steel, with a nickel cylindrical anode and leads. This unit will also handle hydrogen-deuterium mixtures, and its specific purpose is:

1. To determine the feasibility of continuous maintenance-free operation.
2. To determine the best method for movement of materials through the electrolysis system.
3. To establish design criteria for a three-cell pilot plant unit.

Three-cell unit - this unit will serve as a pilot plant for a large-scale production unit. Each cell will be from two to four liters in volume, approximately the same size as the previous cells, but in addition will also handle ternary mixtures of hydrogen-deuterium-tritium. The specific purpose of this unit is:

1. To establish design criteria for production units.
2. To investigate the effect of changes in operating variables (current, pressure, temperature, and flow rate) upon the separation factor.
3. To demonstrate the feasibility of operation of such units without loss of products.
4. To determine the extent to which maintenance can be safely done.

In all three units separation factors will be determined and used as a measure of the effect of changing operating variables.

Capacities

In all of the experimental units above the feed mixtures will be used at flow rates in the range of ten to fifty milliliters of liquid per hour, with gas evolution flow rates in the range of ten to fifty liters of hydrogen per hour.

In the one-cell and two-cell units only H_2O - D_2O mixtures will be used, but in the three-cell unit H_2O - D_2O - T_2O mixtures will be used, with tritium existing in trace amounts.

Work Schedule

The experimental cells will be operated on a one shift per day basis; however, storage and processing equipment will be installed in such a manner as to allow continuous operation if necessary.

Process Flow Sheet

A flow sheet which indicates the basic operations for the three-cell unit is shown in Sketch No. 1 attached. The evolved gases (H_2 and O_2) flow counter-currently to the liquid (D_2 and T_2 enriched water), and are recombined (in burners) to form water and sent to the waste drain. The enriched water fraction will be collected in a reservoir for possible recycling. Assay of feed and products will be accomplished quantitatively by a mass spectrometer. An adequate refrigeration system will be provided for drying the evolved gases, and condensing the products of combustion and distillate.

Operating Personnel

The electrolysis development subproject will require five development personnel to complete this part of the work.

Health and Safety Requirements

The usual Mound Laboratory health physics practices will be followed. During the early runs with hydrogen-deuterium mixtures

a canopy-type hood will be installed over the electrolysis cells and auxiliary system, through which a large portion of the room air will be exhausted. This will reduce the hazard of accumulating hydrogen and deuterium in explosive quantities and mixtures. During the trace tritium runs transparent walls will be attached to this canopy to insure proper ventilation and provide a protective barrier between personnel and equipment. The processing equipment itself is a gas-tight system which will provide additional protection. Continuous air monitoring will be instituted not only in the operating areas but also in the canopy ventilation system.

Accountability

The accountability of the trace amounts of tritium involved in the experimental work will be the responsibility of Process Development personnel.

Security

No new or additional security problems are anticipated from this work when only hydrogen-deuterium runs are being made. When trace-tritium runs are being made, the same security regulations will apply as those that are in force in the adjacent SW area in which Production Recovery is to be located.

Site Selection

The site selected for the experimental electrolysis cells is Room 111 of the "R" Building. This site was selected on the basis of available floor space and non-interference with other work.

D. Preliminary Schematic Plans

The attached Sketch No. 1 is a typical flow sheet for a three-cell electrolysis unit. All items which can be tested individually

such as burners, refrigeration, etc. will be tested prior to installation. Sketch No. 2 attached shows the general position and space for the experimental equipment in Room 111 of the "R" Building.

E. Outline Specifications

All experimental equipment can be installed in place without any building modifications being required. The cells will be mounted on a reinforced table with a canopy-type hood over this table. Some modification will be required in ventilation ducts to provide spot ventilation at this equipment. Utility services will have to be extended to attach to this experimental equipment.

F. Summary Cost Estimate

The accompanying preliminary estimate forms a part of this proposal:

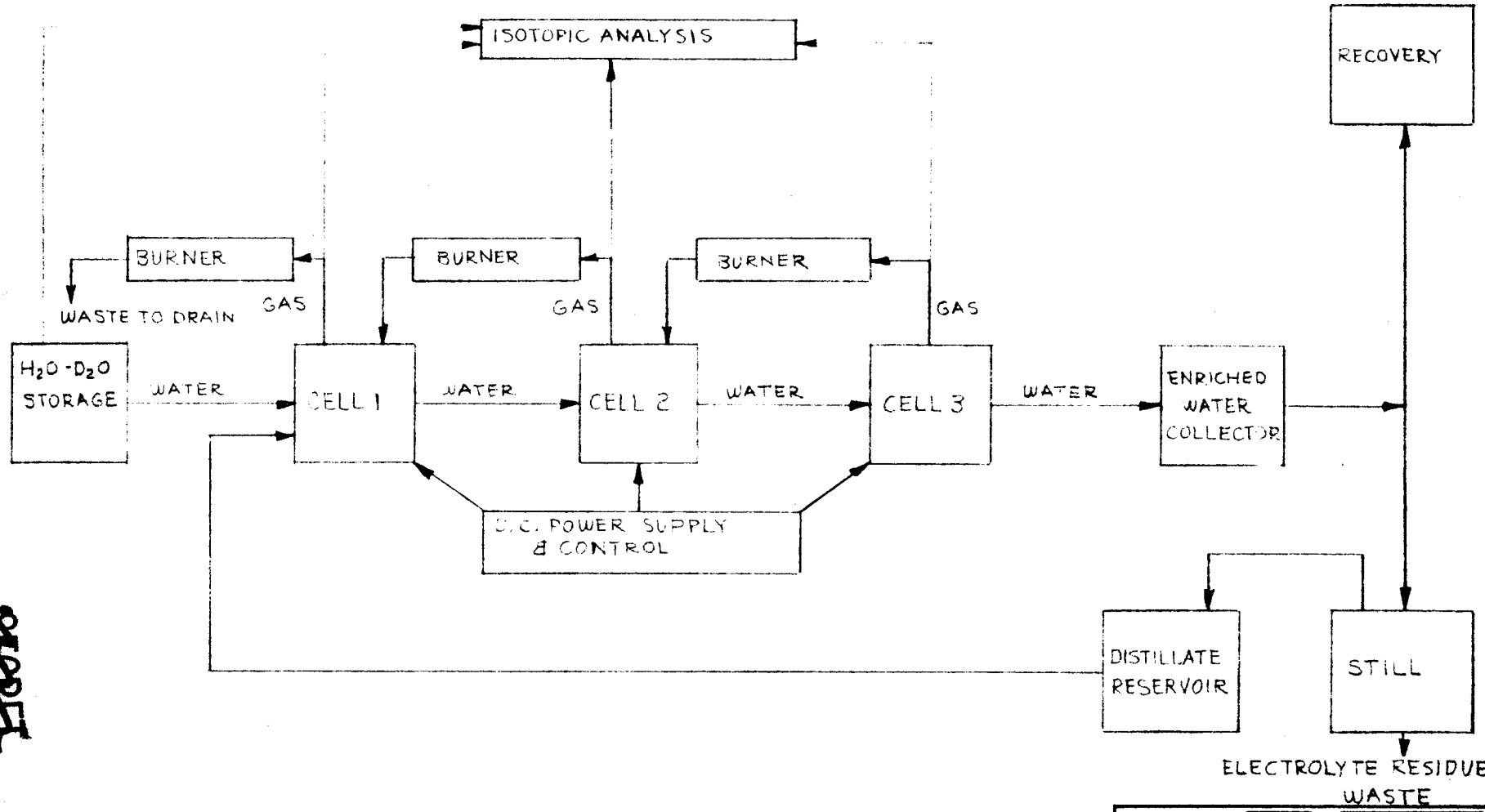
Cost Category	Participant Monsanto	Total
Direct Construction Costs		
Installed for Fixed Equipment	$45,100.	$45,100.
Engineering Design and Inspection	10,900.	10,900.
Indirect Costs	9,600.	9,600.
Allowance for Contingencies	13,100.	13,100.
Total Gross Project Cost	$78,700.	$78,700.

G. Floor Areas, Gross Cubage and Unit Cost Data

Since this project does not involve construction of a new building or work involving an addition to an existing structure, no floor area, gross cubage or unit cost data is furnished.

4. Proposed Starting and Completion Dates

Actual subproject work will begin immediately after the directive is received. Assuming a starting date of March 1, 1954 the subproject will be completed by February 28, 1955. Parts of the work (one-cell and two-cell units) will be completed prior to this date.



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MOUND LABORATORY
OPERATED BY
MONSANTO CHEMICAL COMPANY
MIAMISBURG OHIO

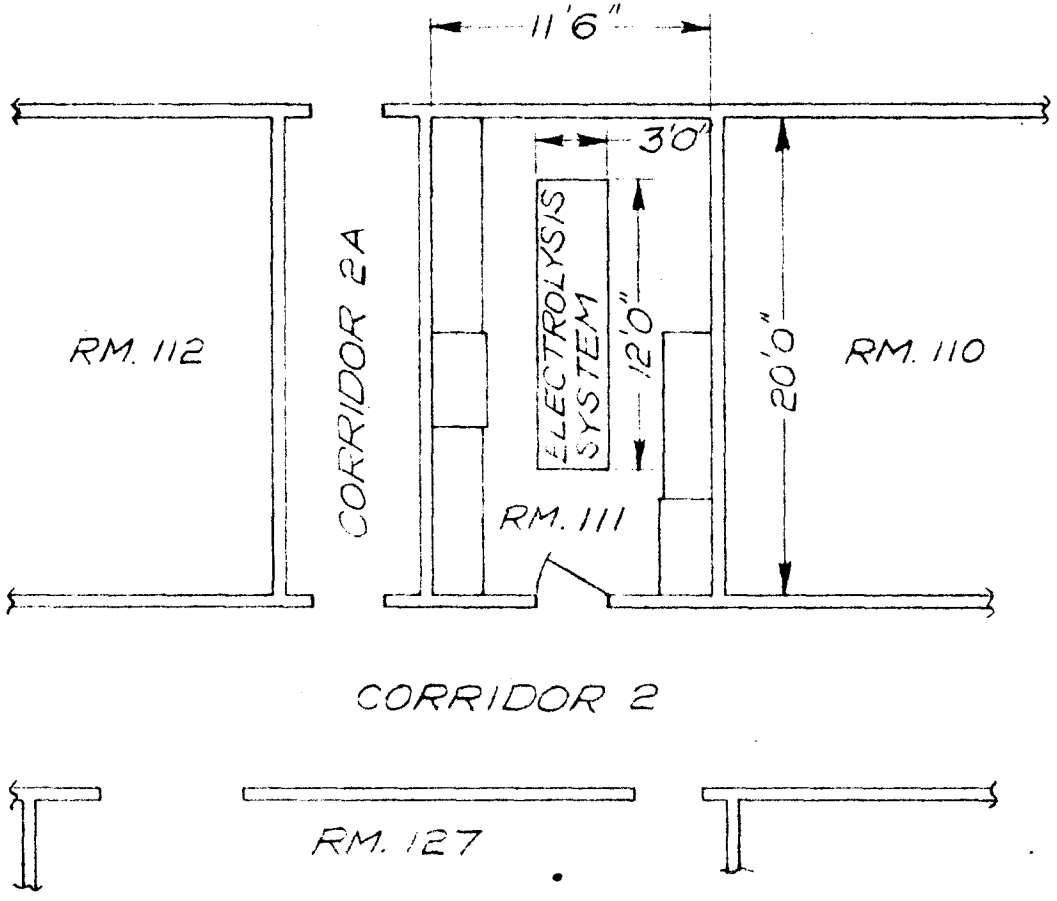
FLOW SHEET FOR A THREE-CELL ELECTROLYSIS UNIT.

DRAWN G. BERNDT DATE 1-29-53
CHECKED WER DATE
APPROVED DATE
JOB NO.
SCALE

DWG. NO. 1- SKETCH 1.

NO.	DATE	REVISION	BY	CHK'D	APPROVED

-1



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PROPOSED FLOOR PLAN FOR ELECTROLYSIS DEVELOPMENT FACILITY RM. 111 OF "R" BLDG.

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SKETCH NO. 2

DRAWN C. SCHLOSSER DATE 2-4-54
CHECKED WER DATE
APPROVED DATE
JOB NO.
SCALE 1/8" = 1'0"

DWG. NO. 1-

NO.	DATE	REVISION	BY	CHK'D	APPROVED