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# GENERAL PHILOSOPHY UNDERLYING THE DESIGN OF THE GAS PREPARATION AND CRYOGENICS PHASE OF THE PRODUCTION RECOVERY FACILITY

[redacted]

## INTRODUCTION

This report will deal primarily with the major premises forming the basis of the design of the cryogenic and gas preparation portions of the production recovery facility. The major premises are divided into three groups as follows:

I. Premises associated with the recovery process.
II. Premises associated with the equipment.
III. Premises associated with the recovery area.

Where desirable justification of a premise will be included. This report should not be confused with the document outlining detailed specifications that is now in preparation.

I. Recovery Process

A. The recovery plant is to be designed to handle, in two shifts per day, the daily recycle rate as of March 1957.

B. In addition to item "A" the recovery plant is to be designed to handle the recoverable losses from the processing and fabrication lines recovered as water from the atmosphere of the lines.

C. The following are the compositions of materials that should not be sent to the recovery plant for isotopic separation of the contained hydrogen.

1. Recycle hydriside material containing less than one mole per cent of protium should not be submitted for isotopic separation of protium. The gas going into the processing lines is to have a protium content of one mole per cent and this is expected to increase during processing and fabrication. The above protium specification may be higher as experience and/or official specification allow. Material meeting the above specification may be sent to recovery for the separation of helium three.

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2. Water from the Lectrodryer units containing less than 0.1 mole per cent of tritium will not be processed for tritium recovery. This limitation was arrived at by comparing the estimated cost of operating the recovery plant to the estimated value of the tritium to be recovered. This ratio of value to cost is within a factor of two of being unity.

D. The material coming from the stills as raffinate will be disposed of as waste if the tritium content is not more than 1 mole per 1000 moles of protium.

E. The material coming from the stills will be considered final product if the protium content is not more than 1 mole per 100 moles of tritium. Items "D" and "E" imply a factor of $10^5$ in the separation of protium and deuterium in the stills.

F. The gas samples taken for analysis should be finally collected in disposable form. The tritium lost in analysis is small compared to that to be lost in the waste from the recovery plant. From the standpoint of security the release of tritium should be held to a minimum. Burial of the waste products should be given close consideration.

G. The materials received for recovery are to be processed in batches with the material low in tritium being kept separate from that high in tritium.

H. A place should be provided in the storage area for introduction of gas for processing.

I. The mass balance between incoming and outgoing material based on tritium should be 0.1 per cent or better using calorimetric methods in assay supplemented by counting methods applied to materials of extremely low tritium concentration.

II. <u>Equipment</u>

A. There will be two stills, one for gas of low tritium concentration and one for gas of high tritium concentration. The still for processing the low concentration material will be capable of operating on an initial batch of 800 milliliters of liquified gas and will process this charge in an 8-hour day. The still for processing the high concentration material will be capable of operating on an initial batch of 300 milliliters of liquified gas and processing this charge in an 8-hour day. The 800 milliliter charge will contain 10 grams of tritium and the 300 milliliter charge will contain 25 grams of tritium.

B. The recovery plant, when operating at full 8-hour per day capacity will consume liquid hydrogen at a rate equal to the 8-hour capacity of the liquid hydrogen plant.

C. The following units in the gas preparation area will be disposable units.

1. The amalgamators.

2. The liquid nitrogen traps.

3. The first still that serves as a transfer container.

4. The electrolysis cell with burners and condensers.

D. The following units in the cryogenics area will be disposable units.

1. The cryogenic stills.

2. The raffinate collecting containers.

3. The product collecting containers.

E. Provision will be made for minor repair of all valves and replacement of valves through gloveports.

F. The following dryboxes or hoods are to be separate units flanged and gasketed so that they form airtight assemblies.

1. Amalgamation box.

2. Gas storage box.

3. Electrolysis box.

4. Raffinate storage box.

5. Still box.

6. Product box.

G. The atmosphere of all dryboxes shall pass through a recombiner.

H. All vacuum pumps that evacuate any units or manifolds that has held or transferred gas or liquid that contains the isotopes shall exhaust to the recombiner.

I. The dryboxes shall have argon atmospheres as follows:

1. The supply of each box shall have passed through a recombiner to reduce contamination.

2. Each box shall have a separate supply and exhaust from headers.

3. The pressure inside each dry box shall be slightly less than outside.

4. The argon as supplied shall contain not more than 2 per cent oxygen.

5. There will be 30 changes per hour of atmosphere in the boxes.

6. The temperature in the boxes will be 75° ± 2°F.

7. No liquid nitrogen shall evaporate into the dry boxes.

III. <u>Recovery Area</u>

A. The temperature in the analytical area shall be 75° ± 2°F and the relative humidity shall be 50 per cent or less. There shall be 10 to 12 air changes per hour.

B. There shall be 10 to 12 air changes per hour in the gas preparation and cryogenic area and the pressure shall be less than that in the analytical area. Means shall be provided to heat the air supply to 75°F during cold weather.

C. The various areas are to be separated by walls and interconnected by doorways. Movement from one area to another shall not require passing through the analytical area.

D. The high pressure refrigeration plant shall be located outside the SW Building in a lightly constructed building near the still area. This building shall have natural draft ventilation with an emergency exhaust fan to supply 50 air changes per hour.

E. The refrigeration area and still area shall be connected by a blast-proof door that will swing into the refrigeration area and be able to withstand a maximum blast pressure of 12 atmospheres.

F. The mechanical equipment area shall have 20 air changes per hour. The area shall be accessible through an airlock.

G. Compressed and filtered air shall be supplied for use with protective suits near all dryboxes, operation area entries and in the mechanical equipment area.

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