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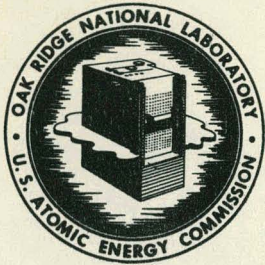
OAK RIDGE NATIONAL LABORATORY

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DATE: June 28, 1956
SUBJECT: Processing Fuel Solution of the HRR
TO: Distribution
FROM: R. A. McNees

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DATE MAR 19 1957 *let*
For The Atomic Energy Commission
H. F. Canale
Chief, Declassification Branch

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PROCESSING FUEL SOLUTION OF THE HRR

A flow diagram, see attached figure, depicting the method proposed for processing the fuel solution of the HRR has been prepared; the following is an explanation of the process principles upon which this diagram is based.

The fission and corrosion product solids produced in the reactor will be about 20 pounds/day based on 500 megawatts thermal energy and corrosion rates of 1 or 10 mpy for stainless steel and 70-80 mpy for Zircaloy-2. These solids would be concentrated into 750 liters per day of fuel solution. This concentration would be accomplished by use of hydroclones with self-contained underflow pots. Two such sets of clones would be provided so that one set would be operating at reactor temperature while the other, with its pot and collected solids, was being cooled, discharged and reheated.

In order to simplify the discussion of chemical processing, the underflow pot while operating at 275°C shall be considered as containing, in addition to D₂O, five distinct chemical species. These are as follows:

1. Soluble uranium.
2. Soluble fission and corrosion product sulfates.
3. Insoluble rare earth sulfates.
4. Insoluble fission and corrosion product oxides and sulfates.
5. Insoluble uranium.

After cooling to 100°C the rare earth sulfate dissolves and a separation of liquid from solid phase accompanied by suitable washing of solids with D₂O separates the major portion of the uranium from the bulk of the fission and corrosion product solids. These solids would be slurried in D₂O to a receiver from which D₂O would be recovered. This receiver would be disconnected from the reactor system before H₂O

was added and would never be used in conjunction with a D_2O system again. The solids would be subjected to suitable storage treatment. Laboratory experiments indicate that twenty pounds of such solids would contain about 0.2% uranium or about 18 g of total uranium per day. The U^{235} content would be less than 2 g and recovery from such high level waste seems at this time to be of doubtful value.

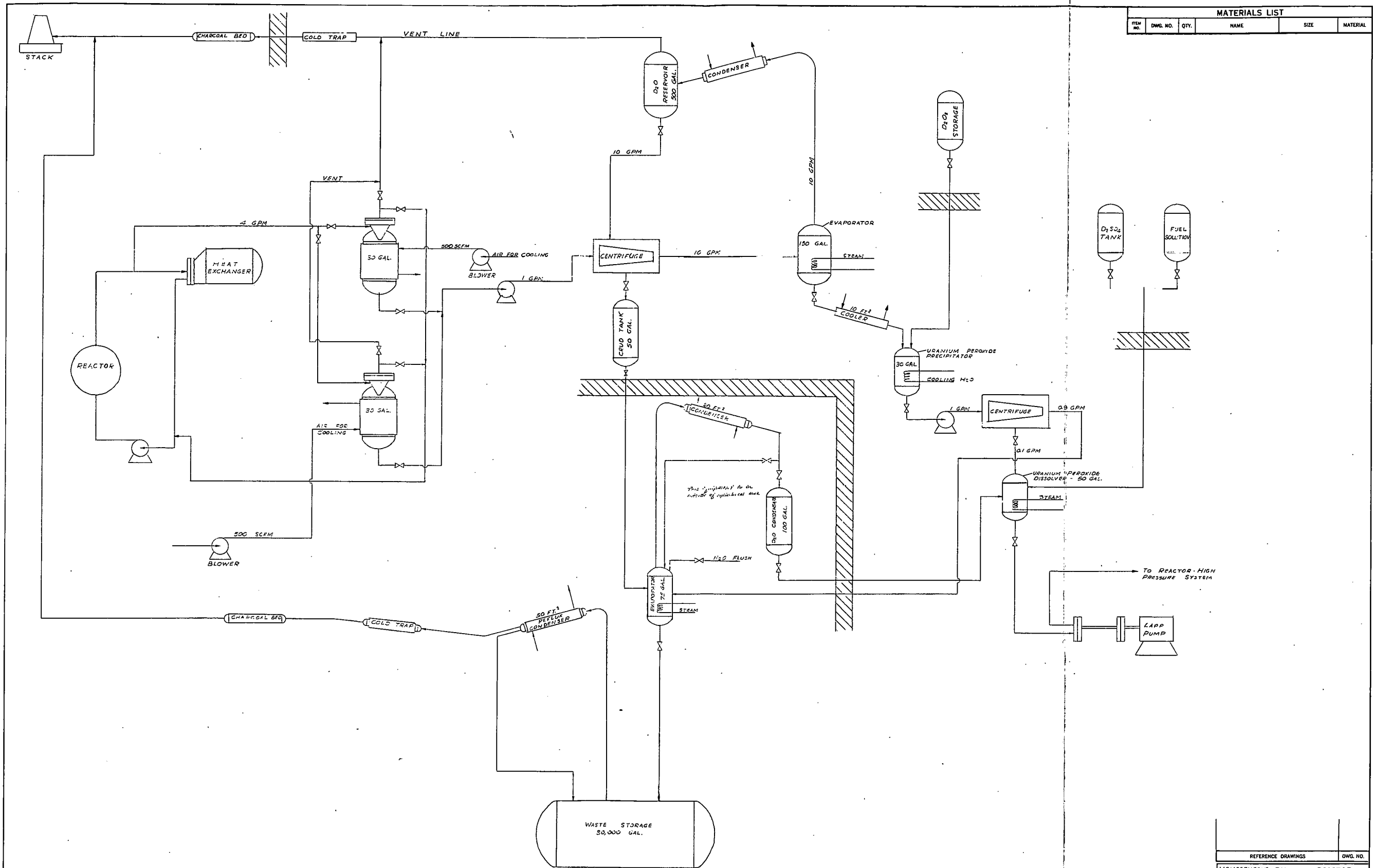
The solution of soluble uranium, fission and corrosion products would be cooled to $30^\circ C$ and D_2O_2 added. The precipitated uranium peroxide would be separated from the soluble fission and corrosion products and washed with D_2O . The waste products would go to the above mentioned receiver for D_2O recovery and would then be stored. Recovery of high-activity cesium prior to combining the soluble waste with the insoluble oxides may be an attractive variation of the basic scheme.

The precipitated UO_4 would be slurried in D_2O along with D_2SO_4 and heated to about $150^\circ C$ to destroy the peroxide and give UO_2SO_4 for return to the reactor.

The usefulness of the proposed scheme would be dependent upon the outcome of development and research work but is believed to be entirely feasible and represents an important and necessary step forward in the processing of homogeneous reactor fuels.


R. A. McNeas

RAM/jr



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ITEM NO.	DWG. NO.	QTY.	NAME	MATERIAL

NO.	REVISIONS	DATE	APPR.	APPR.

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REFERENCE DRAWINGS	DWG. NO.

HOMOGENEOUS RESEARCH REACTOR	
PRELIMINARY FLOW DIAGRAM OF HRR CHEMICAL PROCESSING PLANT	
OAK RIDGE NATIONAL LABORATORY	
OPERATED BY CARBIDE AND CARBON CHEMICALS COMPANY	
A DIVISION OF UNION CARBIDE AND CARBON CORPORATION OAK RIDGE, TENNESSEE	
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