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SUBJECT: HRT Uranyl Sulfate Start-Up Procedure

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Chief, Declassification Branch

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HRT URANYL SULFATE START-UP PROCEDUREI. PRELIMINARY SHAKEDOWN TESTING

Before the start-up procedure is begun it is presumed that construction and preliminary shakedown testing of the HRT will have been entirely completed. Such shakedown tests should be done with distilled or demineralized water meeting the water specifications outlined in Table I. It is recommended that these tests be run without oxygenation unless oxygenation is necessary; for example, in testing the oxygen addition equipment. The oxygen concentration should be limited to 50 ppm except for such periods as may be necessary to check the ultimate capacity of the oxygenation equipment. During these tests the water should be replaced if the pH gets outside the range 4 to 7, or the Cr concentration exceeds 50 ppm.

Analytical samples may be taken as infrequently as once daily during this period. Conductivity, pH, total Cr and semi-quantitative spectrographic analysis should be adequate for preliminary examination of these samples. Further analysis will be specified by E. L. Compere if required.

One liter representative samples are to be obtained from the solutions charged to and withdrawn from the system. These are to be stored until disposal is specified by E. L. Compere.

II. CLEANUP

When the system is adjudged completed with no further alterations or shakedown tests anticipated, the following cleanup procedure is recommended:

A. Tri-Sodium Phosphate Wash

1. Wash with tri-sodium phosphate solution (3%) at 100°C for 3 hours. In addition to regular one liter representative samples, obtain samples at all system sample points halfway through the run and on completion of the run. Analysis to be specified by E. L. Compere.
2. Rinse to pH 7, and specific resistance greater than 25,000 ohm-cm, with distilled or demineralized water meeting specifications given in Table I.
3. Treat with 5% nitric acid at 85°C for 48 hours. Analytical samples should be obtained from the high pressure system twice per shift and from all sample points at least once daily. Analysis should be run for iron, chromium, nickel, zirconium, total acidity, copper silver, aluminum, cobalt, chloride, phosphate, and semi-quantitative spectrographic analysis obtained. The long period of operation recommended at this time compared to that used for the HRE stems from the fact that the 5% nitric acid solution at 85°C has proven very useful in picking up off specification materials. In particular, it has shown up stringer type occlusions which penetrated the wall in some components.

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4. Flush with distilled or demineralized water meeting specifications in Table I, until a pH greater than 4 is obtained, and a specific resistance greater than 25,000 ohm-cm.

5. A repetition of the hydrostatic test of the equipment may be desirable at this point, although one is to be made later after completion of natural uranium runs.

B. Pre-Treatment

Run with distilled water at 50 ppm oxygen for one to two hundred hours at 280°C. Samples should be obtained at all sample points shortly after start-up and once daily thereafter. Analysis should be for chromate, chloride, oxygen gas, sulfate (as required), pH, conductivity, CO₂.

III. SOUP STARTUP

Put fresh distilled water into the system. Bring the system to operating conditions. Verify proper function of oxygen addition system by sampling and analysis. Add uranyl sulfate, sulfuric acid and copper sulfate as indicated in Table II.

Samples for solution analysis should be taken twice per shift, with analysis on each sample for pH, U, Ni, Cu, Cr, and solids. Daily analysis should include: Zr, SO₄, Co, total acidity, semi-quantitative spectrographic analysis of solution and solids; and analysis for dissolved O₂, CO₂ and inert or residual gases.

IV. NATURAL URANIUM REMOVAL

After the natural uranium runs are completed, the system should be rinsed out with distilled or demineralized water meeting the specifications of Table I, until a pH of 4 is exceeded, the resistivity is greater than 25,000 ohm-cm, and the uranium concentration is less than 100 ppm. Rinses should completely fill system to recombiners or beyond.

The system may then be subjected to hydrostatic testing, followed by removal of all water from the system, by heating low areas while pulling a vacuum on the system.

A helium leak test may be run on the system. The system should then be in shape, as far as factors affecting the soup are involved, for beginning the D₂O-enriched uranium start-up.

V. D₂O AND 25 OPERATION

When system goes to power every effort should be made to meter O₂ consumption as a measure of Xr corrosion.

VI. CORROSION SPECIMENS

Placement of corrosion specimens is a separate problem for each environment and component. We recommend at present placement according to Table III. Duplicate samples are desirable where feasible.

TABLE I

Specifications for Distilled or
Demineralized Water for HRT use

Resistivity, meg ohm-cm	0.3	minimum
Total Solids, ppm	2	maximum
pH	5	minimum
Cl, ppm	0.1	maximum
F, ppm	0.1	maximum

TABLE II

Solution Composition and Time Schedule for HRT Start-up

^{U238} Concentration (m)	Cumulative Time, (hrs)*	CuSO ₄ (m)	H ₂ SO ₄ (m)	O ₂ ppm
0	50	0	0	50-100
0.004	150	0	0.004	"
0.01	250	0	0.004	"
0.02	350	0.005	0.006	"
0.04	550	0.005	0.015	"

* Operating hours at 280°C

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TABLE III

Desired Placement of Corrosion Specimens in HRT

Component	347 Liq. Vap.	309 SCb Liq. Vap.	Zr-2 Liq. Vap.	Ti Liq. Vap.	Stellite Liq. Vap.	Graphitar Liq. Vap.	Other
Core	D -	D -	M -	D -	- -	- -	347-Zr-2 Couple
Heat Exchanger Steam Side	M M	M M	- -	M M	- -	- -	Carbon steel, Carbon St-347 Tube assembly Stressed couple
Circulating Lines 300°C	M -	M -	M -	M -	- -	- -	347-Zr-2 Couple
250°C	M -	M -	M -	M -	- -	- -	347-Zr-2 Couple
Condensate Holdup Tank & Recombiner Cond.	M M	- -	- -	- -	M -	M -	Al ₂ O ₃
D Tanks	M M	M M	M M	M M	M M	- -	
Pressurizer	M M	M M	M M	M M	- -	- -	
Evaporators	M -	M -	- -	M -	- -	- -	
Letdown Lines	M -	M -	- -	M -	M Low Temp. End	- -	
Blanket Pressure Vessel	D D	D D	D D	D D	- -	- -	
Off gas Line	- D	- D	- -	- D	- -	- -	
Condensate Region below Turbine	D D	- D	D -	D D	- -	- -	

D = Desirable.
M = Must.

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