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FROM: H. F. McDuffie

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HRP GROUP LEADERS MEETING, MAY 19, 1955HRT Status - S. E. Beall

A detailed construction schedule for the HRT has been prepared by J. P. Jarvis. This schedule calls for completion in February, 1956 with allowance for contingencies. A chart of percent completion vs time will be maintained; a total of 10,186 man days has been scheduled for the period June 1, 1955 through February 1, 1956. Bar charts showing the scheduled and accomplished progress on each job will aid in spotting bottlenecks. Detailed schedules of shop and field manpower requirements have been established. Detailed breakdowns of the individual jobs have also been made for use in estimating manpower and material requirements.

The contractor is working vigorously at the building site. Five-hundred-thousand dollars worth of work has now been approved. Column anchors are being installed, holes in the tank walls are being cut to receive the various piping penetrations, half of the piping is in place, the control rooms are ready for installation of instruments, and the contractor expects to complete the work in the cell by June 1 with Amercoating complete by July 1.

Top plugs and girders are being scheduled for installation by July 1. The high-density concrete blocks are now being poured in Knoxville.

Delivery of major components has been delayed again but should be accomplished by July. The heat exchangers should be completed during the month. The girth weld on the pressure vessel is to be started within a week. Practically all the low-pressure system components are completed; the blanket dump tanks are being held in a partially completed stage until more information from slurry tests is available.

The concrete is in place for the chemical processing area. Steel plates for the cell lining have arrived and the north wall will be lined first. By July 1 the penetrations should be in place, and the overall construction should be 80% complete. The chemical processing design work has been completed, and the processing vessels have been ordered from the shops.

Slurry DevelopmentChemistry and Preparation - J. P. McBride

The immediate objective of this work is development of a blanket for the HRT, but the groups are also interested in developing a better basic understanding of slurries, slurry behavior as affected by radiation, and recombination in slurry systems.

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Preparation of thorium oxide is currently via recalcination, at 650-1000°C, of the oxide formed by low temperature calcination of thorium oxalate, produced from the thorium nitrate obtained in the Thorex process. Impurities are being held to less than 100 ppm except for 300 ppm fluoride and 2000 ppm barium. The sources of these are presently unknown. The effect of change in the calcination temperature on the properties of the oxide is being studied; the surface area, measured by nitrogen adsorption, decreased from 35 to 8 sq m/g as the calcination temperature increased from 650 to 900-1000°C.

The solid characteristics of the various oxides are being studied by several other techniques; x-ray diffraction measurements indicate the crystal size, and a thermogravimetric technique gives additional information concerning solid phase reactions.

The particulate properties are of interest. A sedimentation technique has been developed for determining particle sizes down to 0.2-0.7 μ . A logarithmic distribution of sizes is found; the form of the distribution is changed by pumping a slurry.

The effects of additives, such as thorium sulfate and sodium pyrophosphate, are being determined by settling tests.

The rheologic properties of slurries are being explored by high temperature viscometry. The results appear similar to those obtained at room temperature.

Boyd inquired whether the electrokinetic behavior of the slurries was being determined.

Corrosion - G. E. Moore, S. A. Reed

Corrosion results were reported from data obtained in the initial three runs in the 100A loop (C loop). The conditions of these three runs were as follows:

<u>Run No.</u>	<u>Th(g/kg H₂O)</u>	<u>O₂(ppm)</u>	<u>T°C</u>	<u>Time (hrs)</u>
CS-4	285	1000	250	200
CS-5	500	1000	250	200
CS-6	1000	1000	250	172

Of the materials tested, the Stellites, nickel and Hasteloy C were most severely attacked. However, with these the attack rate with slurry of 250 g/kg concentration, was 4-5 fold less than with water alone under the same conditions. Results calculated from weight losses of scrubbed 347 stainless steel coupons exposed at various flow rates showed no indication of a sharp critical velocity. These data were shown on a slide as a plot of flow rate in ft/sec vs corrosion in mpy.

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Each of these runs contained a platinum pin exposed to the slurry at approximately 40 ft/sec. If it is assumed that no chemical attack would occur on Pt under these conditions, a weight loss should serve as an index to mechanical effects, i.e., abrasion or erosion. Weight losses of Pt indicated an attack rate of 0.8-1.5 mpy.

Some difficulty was experienced in maintaining the concentration during these tests - particularly in Runs CS-4 and CS-6. The fluctuation in the concentration during the three runs is shown on the second slide.

In run CS-6 a concentration of 1000 g Th/kg was probably never obtained. There was evidence that solids were accumulating in the lower section of the pressurizer adjacent to one of the pressurizer heaters in the early part of the run (found by using a portable radiation survey meter). After 150 hr operation the system was sparged in an attempt to loosen the cake. Large lumps or agglomerates which were broken loose by this action became lodged in the bypass line and eventually plugged it. The run was therefore terminated after 172 hr.

1/ Some corrosion data have been obtained from specimens contained in an experimental mockup of a small in-pile loop. In general the rates for attack of 347 stainless steel were somewhat higher than those shown for the 100A loop runs. Titanium specimens in each case showed weight gains, and Zircaloy-2 specimens were attacked at the rate of about 8 mpy at a velocity of 40 ft/sec. 1/ (Wide variations in the thorium concentration also occurred during these runs.)

The corrosion behavior of circulating aqueous thorium oxide slurries has been investigated by means of toroids. This technique utilizes a small metal pipe loop half-filled with the material to be circulated; by imparting the appropriate motion to the loop the liquid is caused to form into a slug and to rotate within the toroid. The toroid is equipped with corrosion pin specimens which provide weight change data from which corrosion rates are calculated; the toroid itself serves as a corrosion specimen as well.

2/ Thoria slurries prepared from eleven different sources of thorium oxide (representing oxalate- and formate-precipitated material calcined at 650 or 900°C) have been circulated at 26 fps in type 347 stainless steel toroids. The slurry concentration was varied from 100 to 2300 g Th/kg water over the temperature range 200 to 300°C in the presence and absence of oxygen. Type 347 stainless steel, titanium (75A) and Zircaloy-2 corrosion pin specimens were used. 1/3

3/ Type 347 stainless steel gave a corrosion rate of 5 mpy or less, and titanium and Zircaloy-2 showed even lower rates (about 3 mpy or less) in 1000 g Th/kg water slurries at 26 fps, 250°C and in the presence of about 100 psi oxygen. 1/4 The absence of oxygen produced higher and less reproducible corrosion rates of the steel. With Lindsay #8 thoria (oxalate precipitated, 900°C calcined) there was little change in the corrosion rate at 300°C over that at 250°C. However, at 250°C and 2300 g Th/kg water

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slurry concentration, rates of 27 mpy for type 347 stainless steel and 9 mpy for titanium were observed while Zircaloy-2 remained near 3 mpy.

Additions of thorium sulfate to D-17 thoria (ORNL Thorex material, oxalate precipitated, 650°C calcined) or Lindsay #8 at 500 and 1000 g Th/kg water slurry concentration produced no significant change in the corrosion rates of type 347 stainless steel at 250°C, 26 fps and 100 psi oxygen up to 10,000 ppm sulfate as long as the pH remained at or above 4. Additions of calcium, magnesium or sodium sulfate at the 1000 ppm sulfate level also gave no significant changes in corrosion rates from those obtained without the addition of sulfate.

During the investigations it became quite apparent that the calcining temperature of the thoria and its particle size were principal factors in the behavior of the slurry. Slides of thorium oxide particles taken at 1000 X magnification were shown to illustrate the particle size distribution and nature of some of the thoria under investigation.

Engineering Development - R. N. Lyon

The operating temperatures of the two 100 gpm slurry circulating loops have been raised from 250 to 300°C. These loops, in addition to furnishing information on slurry handling, serve as a source of supply for pumped slurry; as previously noted, some of the rheologic properties of slurries are greatly altered by pumping or other violent agitation.

In the 5 gpm loops any silicate addition produced plugging when the loops were cooled.

Apparatus is being constructed to measure pressure drops in circulating slurries at high temperatures.

Construction of the blanket mockup is continuing; the pressurizer is mounted and the lower half of the sphere is in place. The mockup will be in operation by July 15.

Efforts to achieve a modification of the HRT dump tanks which will permit safe handling of slurries were discussed. With a 24-in.-dia tank 16 ft long, containing baffles, the slurry settled in piles between the baffles. Without baffles about one-third of the tank, downstream from the entrance of the evaporator leg, was clear. Steam sparging along the bottom of the tank appears to be too expensive to contemplate. External heating jackets on the bottom of the tank were effective only in plastering slurry over the top of the tanks. Multiple short slant-leg evaporators were tested as a substitute for a single long evaporator leg; in one test they failed to disperse a thickened slurry. Other variants considered include introduction of steam through a sintered plate, use of a toroidal tank with constant circulation, and use of longitudinal baffles of inverted-vee shape with the angle greater than the angle of repose of settled slurry.

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Swartout inquired as to the status of boiling blanket studies. Lyon reported that tests indicate the power can probably be removed; the main problem remaining appears to be keeping the solid suspended.

Swartout announced that the remaining topic, In-Pile Studies, would be postponed until the next meeting.

H F M Duffie

H. F. McDuffie

HFM:dk

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DOCUMENTS RECEIVED MARCH 17, 1955 - MAY 19, 1955

Date	From	To	Subject
3-17-55	AMBillings	WPWalker	Leak Tests of Ring-Joint Flanged, End Connections on HRT Low Pressure Valves
3-17-55	WRGall	Distribution	HRT Approved Drawings as of 3-14-55
3-17-55	HfMcDuffie		ORNL-1853 HRP Quarterly Progress Report
3-17-55	KHMcCorkle	FLCuller	55-3-120 Recovery of U ²³⁵ from HRE Fuel by the Interim-23 Facility
3-18-55	RWStoughton JHalperin	SEBeall	55-3-111 Determination of Radiochemical Behavior, Alpha Values and Cross Sections Under HRT Conditions
3-18-55	WEClark	Distribution	55-3-106 Static Bomb Radiation Corrosion Data
3-18-55	EGBohlmann	RBBriggs	55-3-123 Crevice Between Heat Exchanger Tubes and Tube Sheet in HR Heat Exchangers
3-21-55	JFEichelberger	KAKraus	Physical Properties Measurements
3-21-55	AMBillings	OSisman	Use of Dow-Corning Valve Seal A (Stopcock Grease) in HRT Valve Actuators
3-21-55	LDresner	Distribution	SRD - Ratio of U ²³² to U ²³³ Produced in the TBR
3-21-55			NNSD-25 Prog. Report - Pressure Vessel and Core Tank for HRT
3-22-55	FCZapp	Distribution	HRT Flowsheets
3-23-55	ASKitzes	DEerguson	Preparation of 300-500 lbs of ThO ₂
3-31-55	LRWeissert	CBGraham	Titanium Program Newsletter
3-31-55	SEBeall	Distribution	Discussion of Slurry Settling in the Blanket Dump Tanks
4-1-55	PRKasten RSStone	Distribution	55-4-19 Cooling of HRT Fuel Solution as a Result of Changing Heat Exchanger Operating Conditions
4-1-55	FCZapp	Distribution	HRT Waste and Vent System Flowsheet
4-4-55	WFTaylor	RBKorsmeyer	Quick-Closing Valves
4-5-55	RHChapman	Distribution	55-4-27 HRT Blast Shield Design Criteria
4-5-55			HRT-1026: Specifications for High Pressure Oxygen Converter
4-5-55	DGThomas	Distribution	55-4-36 Comments on the Erosiveness of ThO ₂ Slurries
4-7-55	FCZapp	Distribution	HRT Equipment Schedule
4-14-55	PRKasten	Distribution	Gas Production in HRT Pressurizer
4-15-55	JAHafford	CBGraham	55-4-92 HRT Mockup Loop Water Operation
4-18-55	I. Spiewak, DSToomb		
4-18-55	SEBeall	FRBruce	Flowsheet Identification Code
4-19-55	HfMcDuffie	Distribution	55-4-109 Minutes of HRP Group Leaders Meeting
4-21-55	SEBeall	Distribution	55-4-126 Pressure Testing of HRT Reactor Pit
4-21-55	SEBeall	Distribution	Tests with Slurry in HRT Dump Tank
4-21-55	JNRobinson	RBBriggs	HRT Roof Girder Revision
4-25-55	WRGall	Distribution	HRT Approved Drawings as of 4-20-55 (Issue No. 3)
4-27-55	LRWeissert	Distribution	Titanium Program
5-2-55	ECMiller	DSBillington	Radiation Damage
5-2-55	JNRobinson	RBBriggs	Column Base Anchorage for HRT Cell
5-4-55	ASKitzes	Distribution	ThO ₂ Requirements
5-4-55	ECMiller	SEBeall	Type 347 S.S. for Use in HRT Dump Tank Entrainment Separator
5-5-55	EFStephan	ISpiewak	Solubility Measurements
5-5-55	RVanWinkle	WRGall	55-5-43 Fuel Feed Cooler (Item 17)
5-6-55	ASKitzes	Distribution	Peptized Th(OH) ₄ Slurries
5-9-55	PRKasten	Distribution	55-5-51 Homogeneous Reactor Safety

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Date	From	To	Subject
5-10-55	MTobias	Distribution	55-5-66 Fluxes at the Inside Surface of the Pressure Vessel as a Function of Lethargy for the HRT as Determined from the Univac Eyewash Code
5-16-55	SEBeall	CBGraham	Possible Ignition of Radiolytic Gas by Action of Vapor Relief Valves
5-16-55	SEBeall	SIKaplan	Use of 1/4" Schedule 40 Pipe with Dump Tank Baffle Spacers

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