WTP R&D Plans

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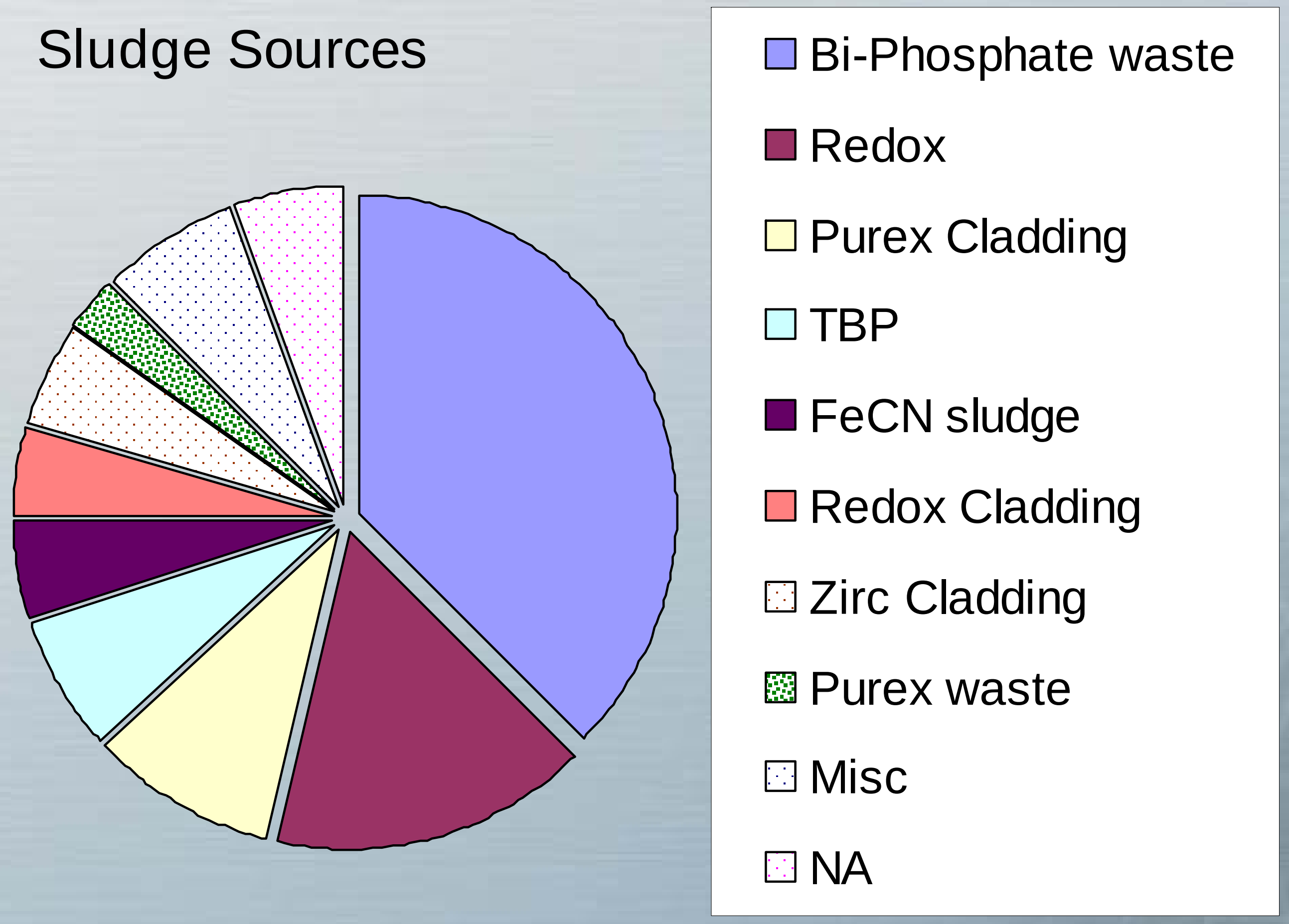
EFRT M-12 Testing Program

- Simulant Development
  - Develop and test gibbsite, boehmite, and filtration component simulants
  - Blend and test component simulants
  - Revise simulants, blend and re-test
- Oxidative Leaching
  - Develop chromium component simulant
  - Titration method development
  - Pu speciation development
  - S-Saltcake/AY-102 Titration and CUF Testing
  - BiPO4 Sludge + Saltcake Titration Testing
- Actual Waste Testing
  - 8 Parametric Tests
  - 7 CUF Tests

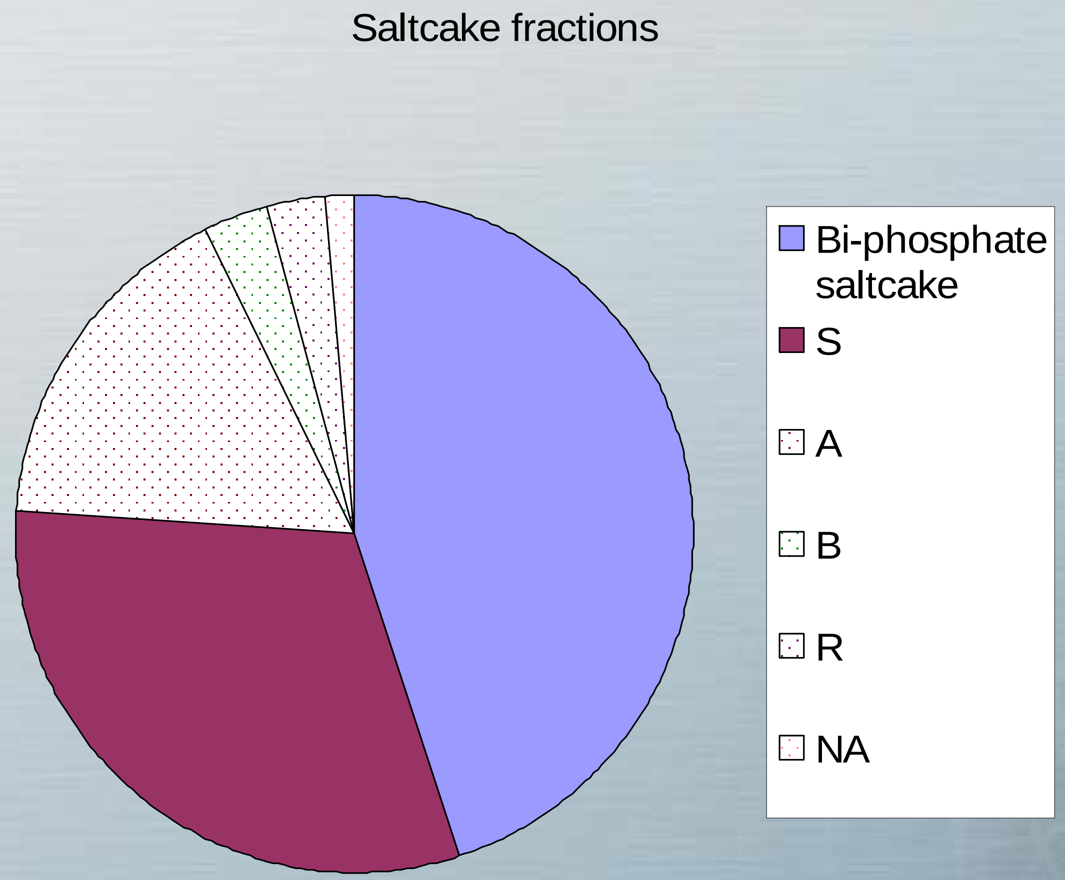
Objectives

- Determine physical and chemical characteristics relevant to leaching and ultrafiltration of actual waste
- Determine dissolution rate of Gibbsite and Boehmite as a function of temperature, $[OH^-]$, over a range of Na concentrations
- Determine dissolution rate of chromium, and extent of dissolution of Pu and safety related constituents as a function of temperature over a range of NaOH concentrations
- Determine dissolution rate of phosphates as a function of temperature over a range of NaOH concentrations
- Determine ultrafiltration flux before and after caustic and oxidative leaching

Propose to study > 75% of sludge waste types



Propose to study > 75% of saltcake waste types



Proposed groupings cover ~ 80% of major components of interest

Tank Waste Inventory

Group ID	Type	Al	Cr	PO_4
1	Bi Phosphate sludge	3%	3%	21%
2	Bi Phosphate saltcake (BY, T)	18%	25%	36%
3	PUREX Cladding Waste sludge	12%	1%	3%
4	REDOX Cladding Waste sludge	8%	1%	0%
5	REDOX sludge	26%	8%	1%
6	S - saltcake (S)	11%	38%	12%
7	TBP waste sludge	1%	1%	8%
8	FeCN wastes	2%	1%	4%
	Balance	19%	22%	14%

Proposed groupings cover ~ 60% of other anions of interest

Group	Type	Oxalate	Sulfate	F
1	Bi phosphate Sludge	2%	6%	12%
2	Bi phosphate Saltcake	36%	43%	36%
3	PUREX cladding	1%	1%	3%
4	REDOX cladding	0%	0%	2%
5	REDOX	3%	1%	2%
6	S-Saltcake	24%	14%	3%
7	TBP Sludge	0%	2%	1%
8	FeCN	1%	1%	1%
	Other saltcake	17%	21%	18%
	Balance of sludge	17%	12%	23%

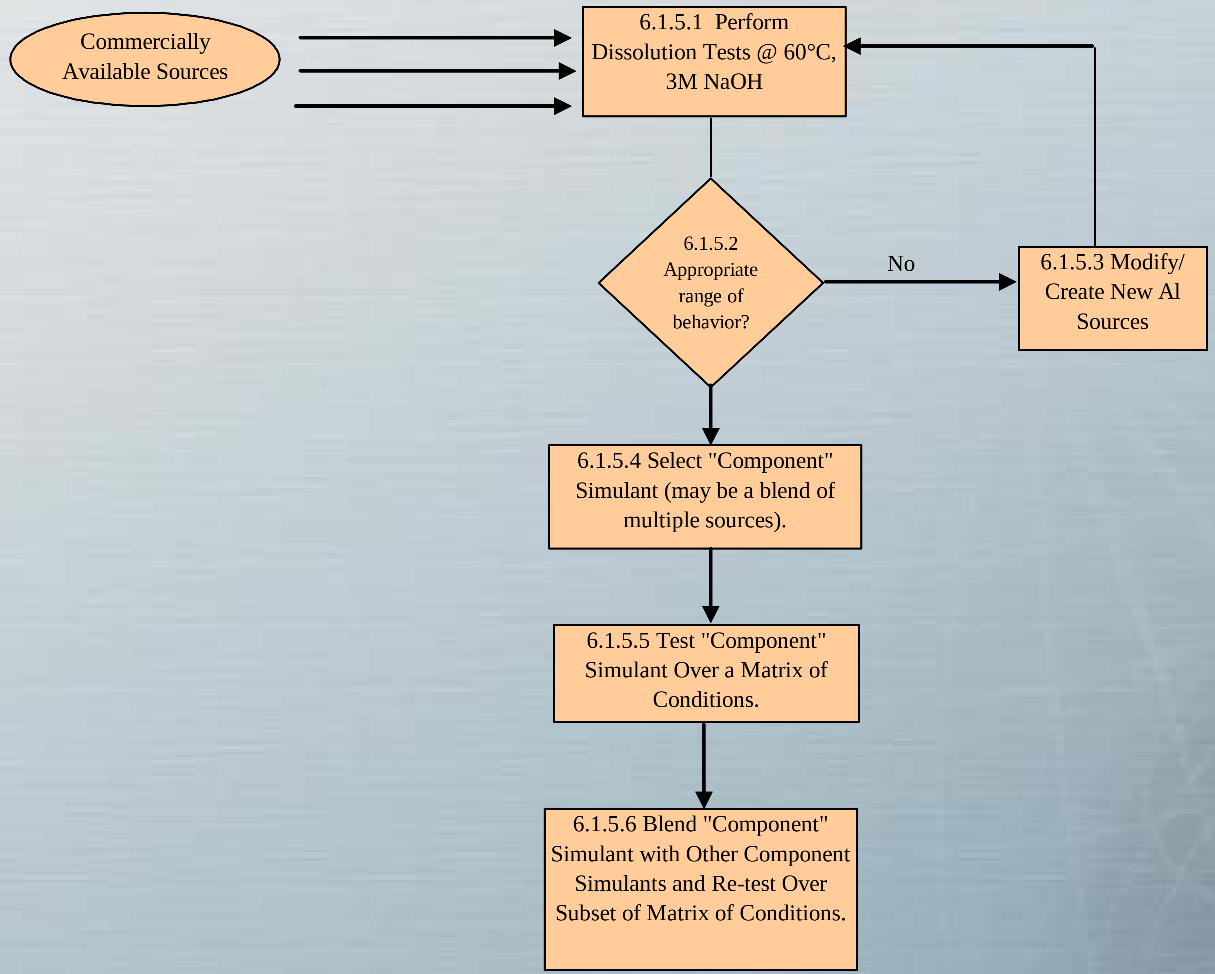
Two Stages of Simulant Development

- Stage 1:
  - Provide component simulants (gibbsite, boehmite, and filtration components) based on existing tank waste characterization data
  - Characterize each component simulant
  - The component simulants are then blended in various ratios, and the performance of the blended simulants is tested
- Stage 2:
  - Refinement of the component simulants based on additional tank waste characterization data
  - Refined components are blended and tested

Gibbsite Simulant Component

- Develop a simulant with physical properties similar to those found in actual waste samples, particularly crystal size and habit
- Develop a correlation that predicts gibbsite simulant dissolution rate as a function of:
  - crystal size
  - crystal habit
  - physical properties

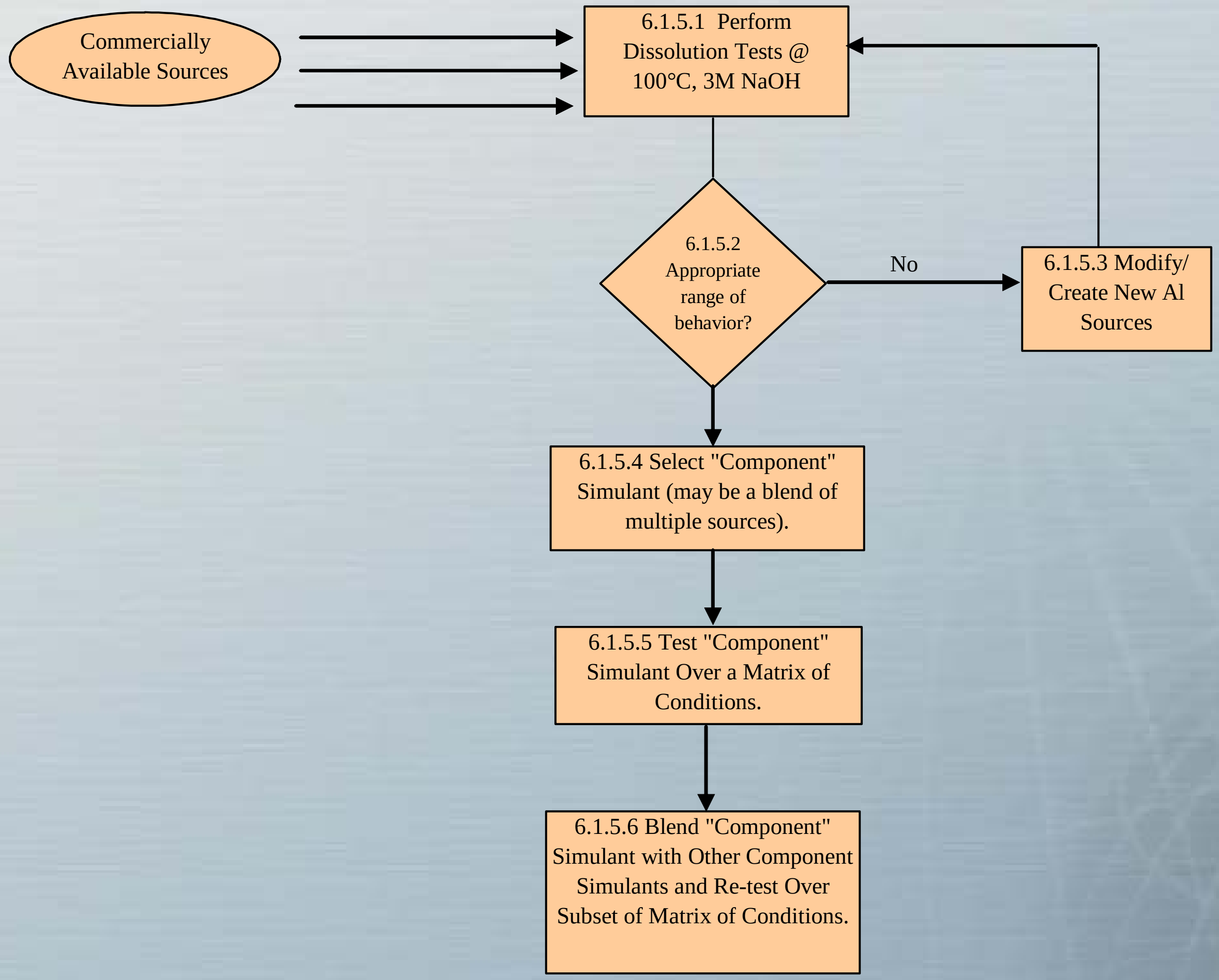
Gibbsite Simulant Development Flowsheet



Boehmite Simulant Component

- Develop a simulant that has a dissolution rate, particulary at 100°C, similar to those found in actual waste samples
- Develop a correlation that predicts boehmite simulant dissolution rate as a function of system properties of:
  - crystal size
  - crystal habit
  - operating temperature
  - hydroxide concentration
  - mixing conditions

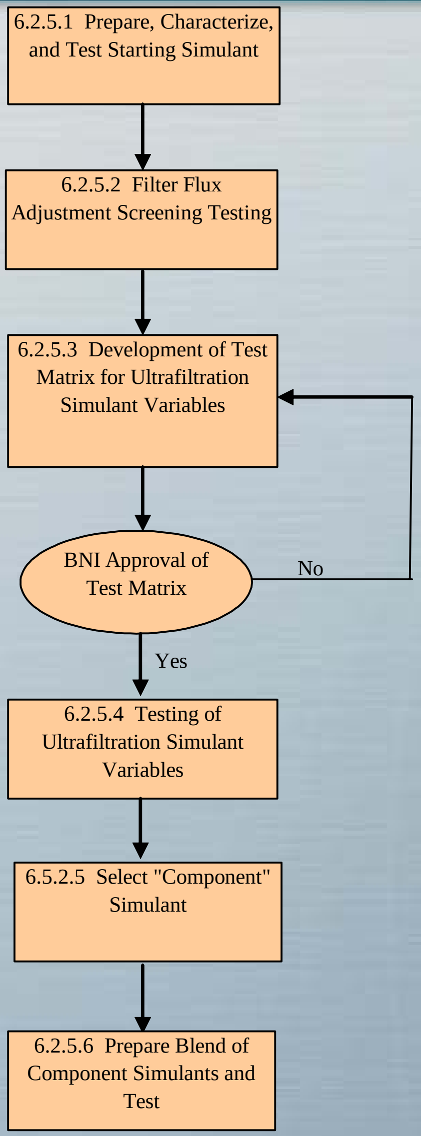
Boehmite Simulant Development Flowsheet



Filtration Component Simulant

- Develop inert ultrafiltration simulant(s) that have filtration behavior that can be related to prior simulant testing and actual waste testing
- Impact of simulant parameters, such as particle size, aging and preparation method on filtration performance will be documented
- Determine correlation of filtration performance with measured physical parameters, such as centrifuged solids and fines concentration
- A laboratory scale CUF system will be used for this performance assessment

Ultrafiltration Simulant Development Flowsheet



Oxidative Leaching

- Develop Chromium Component Simulant
- Titration Method Development
- Pu Speciation Development
- S-Salt/AY-102 Titration Testing
- S-Salt/AY-102 CUF Testing
- BiPO4 Sludge + Saltcake Titration Testing

Chromium Component Simulant

- Composed of pure Cr phases, such as the Cr oxyhydroxides, Cr(O)(OH), observed in Hanford tank sludges and chromium(III) oxide
- Add chemical phases identified in actual Hanford tank sludges
- Non-radioactive simulant will contain the safety-related components: Fe, Mn, Ni, and Zn
- Radioactive simulant will contain U and Pu
- Absolute concentration is unimportant, important to ensure they are present in sufficient quantity to easily determine their behavior duirng the permanganate leaching experiments.
- Target particle size in the simulant is based on data from 32 Hanford tank sludges

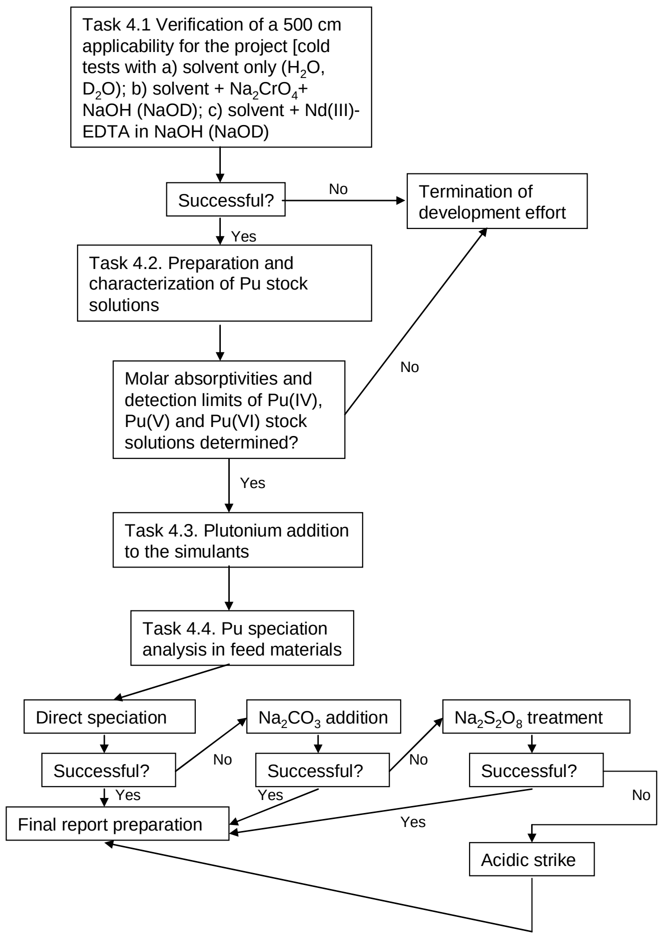
Titration Method Development

- Objective is to determine the speciation of Cr and Mn before and after oxidative leaching
- Characterize the solution oxidation potential eH (electron activity) and pH (proton activity) during oxidative alkaline leaching
- Determine the minimum NaMnO4 dosage required to solubilize the Cr available for leaching in any given waste

Pu Speciation Development

- Devlop a spectrophotometric method to identify Pu speciation at submicromolar concentrations in
  - Alkaline solutions (0.1 to 1.0 M NaOH)
  - In the presence of chromate (0 to 0.05 M) and
  - In the presence of carbonate (0 to 0.1 M)
- Pu(IV), Pu(V), and Pu(VI) hydroxide complexes, as well as mixed hydroxide and carbonate complexes, will be made in the presence of chromate
  - Identify oxidation states of Pu in caustic solution
  - Measure concentrations of the oxidation states in caustic solution
  - Detection limits for each oxidation state of Pu in solution will be determined

Pu Speciation Development Flowsheet



Actual Waste Testing for Chromium

- S-Salt/AY-102 Titration Testing
  - Components are composited in steel vessel
  - Slurry is centrifuged, and supernatant liquid removed or added to give a slurry containing 20 wt% undissolved solids
  - Sample will be caustic leached, then oxidative leached
- S-Salt/AY-102 CUF Testing
  - Sample will be caustic leached, then oxidative leached
- Bi-PO4 Sludge + Saltcake Titration Testing
  - Components are composited in steel vessel
  - Use a slurry containing 20 wt% undissolved solids
  - Sample will be caustic leached, then oxidative leached

Actual Waste Testing

- Parametric Testing
- CUF Testing
- Test blend of reconstituted actual waste samples for filtration

Parametric Tests

- Waste Groups
  - S-Saltcake
  - Redox
  - CWR
  - CWP
  - BiPO4 Saltcake
  - BiPO4Sludge
  - TBP

CUF Testing

- Waste Groups
  - Redox
  - CWR
  - CWP
  - Bi-PO4 Sludge + Saltcake
  - TBP
  - FeCN