R&D Plans for Al Dissolution Process

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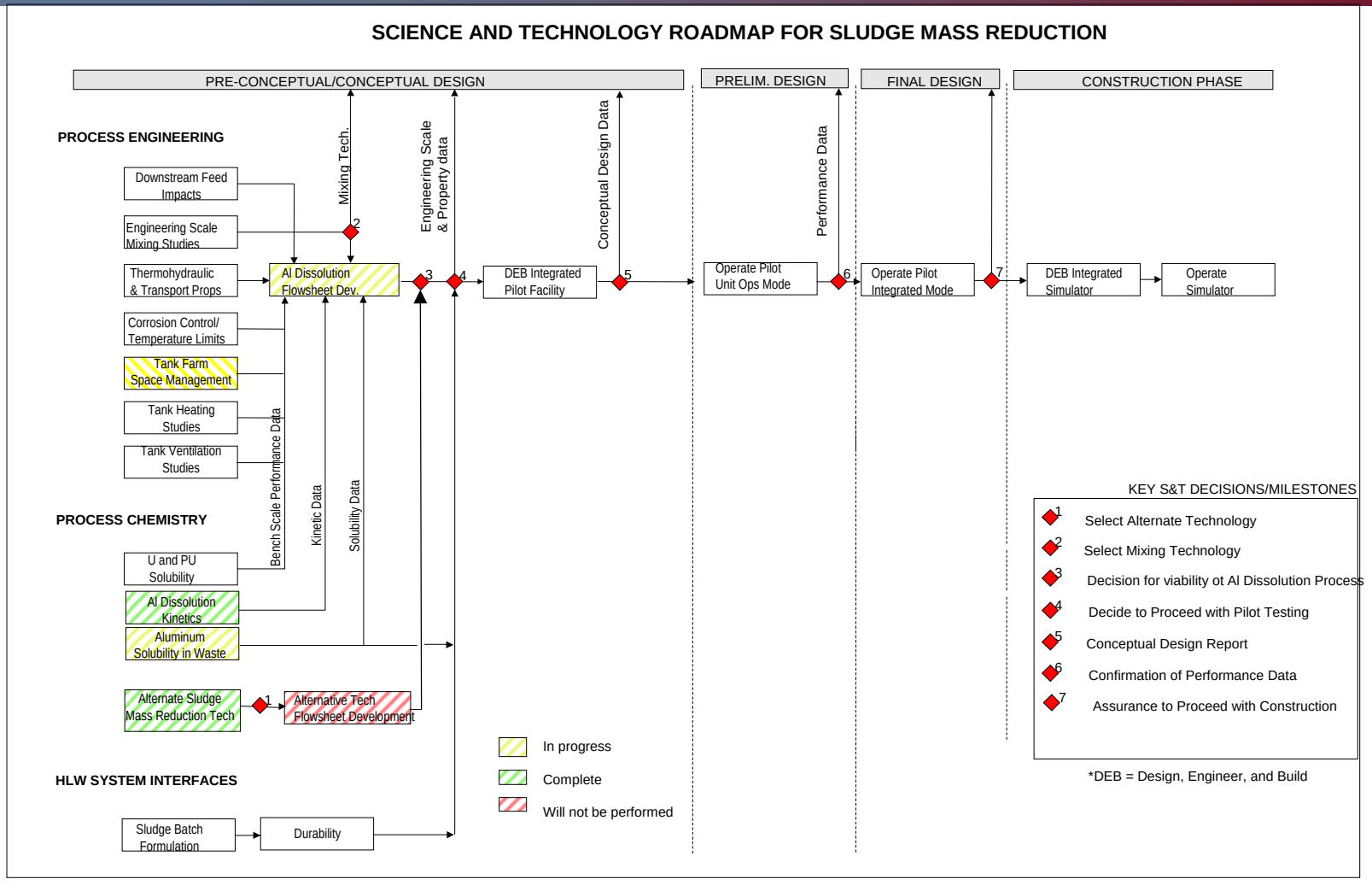
January 24, 2007

LWO-PIT-2007-00008

Technology Roadmap



Process Chemistry

- 9.0 Alternate Sludge Mass Reduction Tech Study
  - 9.1 Identify and evaluate potential alternate technologies to aluminum dissolution to reduce sludge mass and number of glass canisters produced.
    - Evaluation recommended in-tank aluminum dissolution and did not recommend development of any alternatives evaluated.

Process Chemistry

- 7.0 Aluminum Dissolution Kinetics
  - 7.1 Develop a kinetics model for aluminum dissolution using existing and literature data. Identify any data needs. Model completed and no additional data needs identified.
  - 7.2 Obtain laboratory data needed to support development of the kinetics model. No additional data needs identified.

Process Chemistry

- 8.0 Aluminum Solubility in Waste
  - 8.1 Develop solubility and equilibrium model for aluminum under process conditions and under waste storage conditions. Complete
  - 8.2 Determine process conditions necessary to dissolve aluminum from sludge slurry and maintain in solution during storage in the tank farm until final disposal. Complete
  - 8.3 Boehmite in particular is attributed, at least in part, to slow settling of sludge during washing of Sludge Batch 4. Determine how aluminum dissolution would impact sludge settling characteristics.
  - 8.4 Process conditions developed and reported in LWO-PIT-2006-00057 show large interim storage volumes that can not be accommodated in the Tank Farms. Process parameters need to be optimized to minimize interim storage needs prior to startup of the SWPF.

Process Engineering

- 2.0 Engineering Scale Mixing Studies
  - 2.0 Process conditions are incompatible with existing mixing pumps used in waste tanks.
    - 2.1 Determine minimum mixing requirements during dissolution.
    - 2.2 Identify potential mixing equipment that can tolerate process conditions.
    - 2.3 Test mixing equipment under process conditions to verify acceptable functionality.

Process Chemistry

- 6.0 U and Pu Solubility
  - 6.0 Al dissolution demonstration data from 1982 showed solubility differential.
    - 6.1 Determine the relative solubility of fissile nuclides and poisons (Fe, Mn, etc) under process conditions and establish safe operating parameters.

Process Engineering

- 3.0 Thermohydrolic and Transport Properties
  - 3.1 Estimate thermal and hydraulic properties of sludge slurry before and after aluminum dissolution at a range of temperatures (25-100 degrees C).

Process Engineering

- 4.0 Corrosion Control and Temperature Limits
  - 4.0 Limited existing corrosion data exists for proposed Al dissolution process conditions.
    - 4.1 Review available literature data.
    - 4.2 Conduct electrochemical testing within the framework of a parametric test matrix to determine corrosion susceptibility in chemistry and temperature regimes expected during aluminum dissolution.
    - 4.3 In tank chemical analysis would improve batch cycle time by reducing the need to wait for results from the laboratory. Investigate viability in tank methods to determine waste chemistry including aluminum in solution.
    - 4.4 Perform long term coupon corrosion tests.

Process Engineering

- 5.0 Tank Farm Space Management
  - 5.0 Large volumes of Al-rich supernate is generated by the Al dissolution process.
    - 5.1 Adapt solubility and kinetics models to SpaceMan.
    - 5.2 Develop system plan case for aluminum dissolution.

Process Engineering

- 19.0 Tank Heating Studies
  - 19.1 Identify and evaluate potential heating alternative technologies.
  - 19.2 Test identified heating technology to determine viability of deployment in a waste tank.

Process Engineering

- 20.0 Tank Ventilation Studies
  - 20.0 Process conditions create high vapor loads
    - 20.1 Identify and evaluate potential vapor handling methods. Such methods would include increasing the condenser size and/or demister, changing the ventilation flow rate, i.e., fan size, increasing reheater capacity, and adding a chiller to the condenser cooling water.

Process Engineering

- 11.0 Al Dissolution Flowsheet Development
  - 11.1 Establish preliminary aluminum dissolution flowsheet.
  - 11.2 Evaluate potential aluminum dissolution variations. Develop process parameters to minimize space used in the tank farms. Variations would include in-situ processes, potential for evaporation and precipitation of aluminum in a non-sludge waste tank.

High Level Waste System Interface

- 10.0 Sludge Batch Formulation
  - 10.1 Reformulate the sludge batch feed plan to accommodate the sludge mass reduction process.

Process Engineering

- 1.0 Downstream Feed Impact Studies
  - 1.0 Al concentration affects slurry viscosity, melt rate, liquidus temperature, and glass quality at DWPF.
    - 1.1 Determine optimal aluminum concentration in sludge slurry feed for DWPF.
    - 1.2 Evaluate available rheology information on the sludges that have undergone Al-dissolution and assess the impacts on DWPF processing.
    - 1.3 If rheology information is not available, SRNL will perform simulant testing to determine the potential impact.

High Level Waste System Interface

- 13.0 Durability
  - 13.1 Identify candidate frits for specific sludge options.
  - 13.2 Fabricate and test specific glasses, as warranted, to verify predictions of durability, liquidus temperature, viscosity, and/or other properties of interest.