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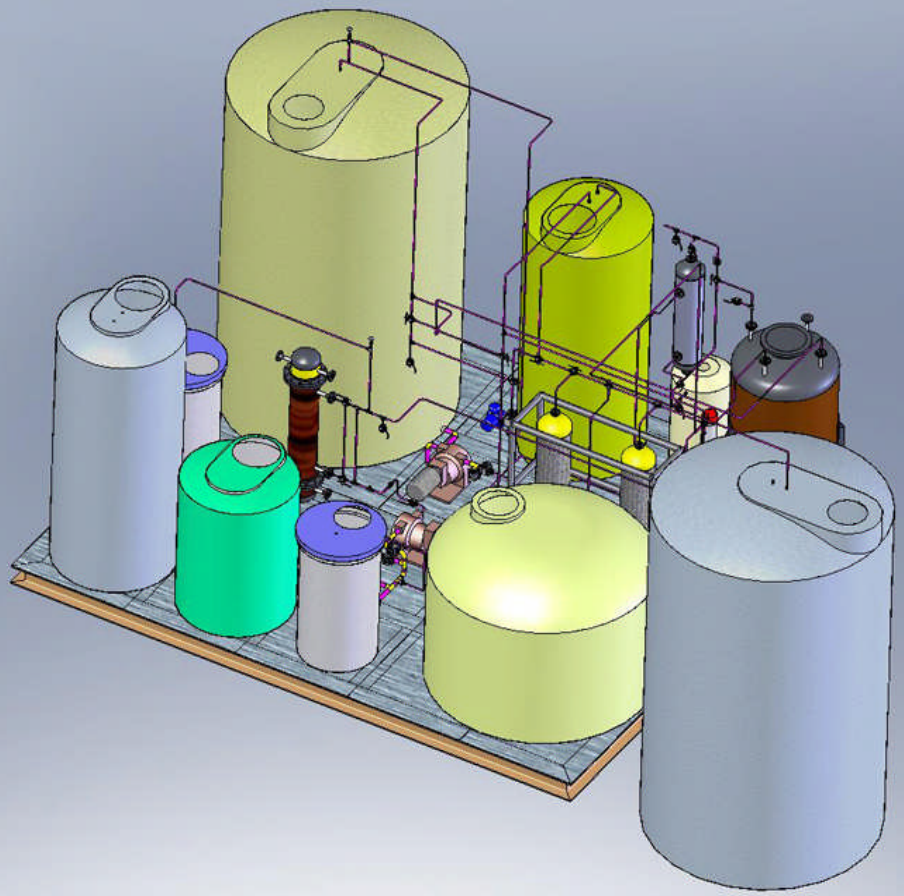
Parsons Infrastructure & Technology Group and
Battelle Memorial Institute

Advanced Remediation Technologies



Near Tank Cesium Removal Using Advanced Ion Exchange

October 23, 2007

Agenda

- Introduction/Overview of Technology
- Phase I Summary Results
- Phase II Planned Activities
- Phase II Expected Results
- Full Field Deployment
- Summary and conclusions

Key Personnel

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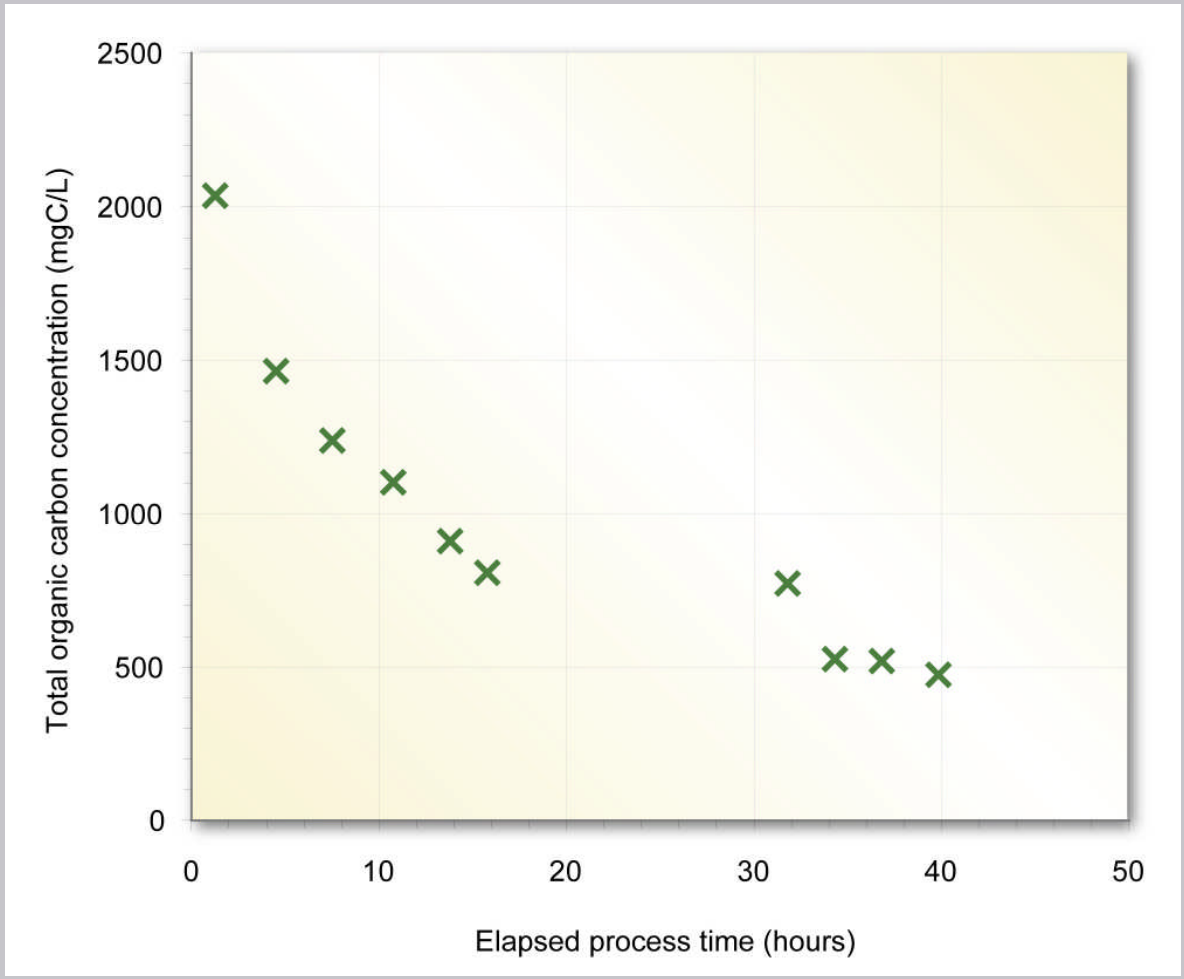
Introduction/Overview of Technology

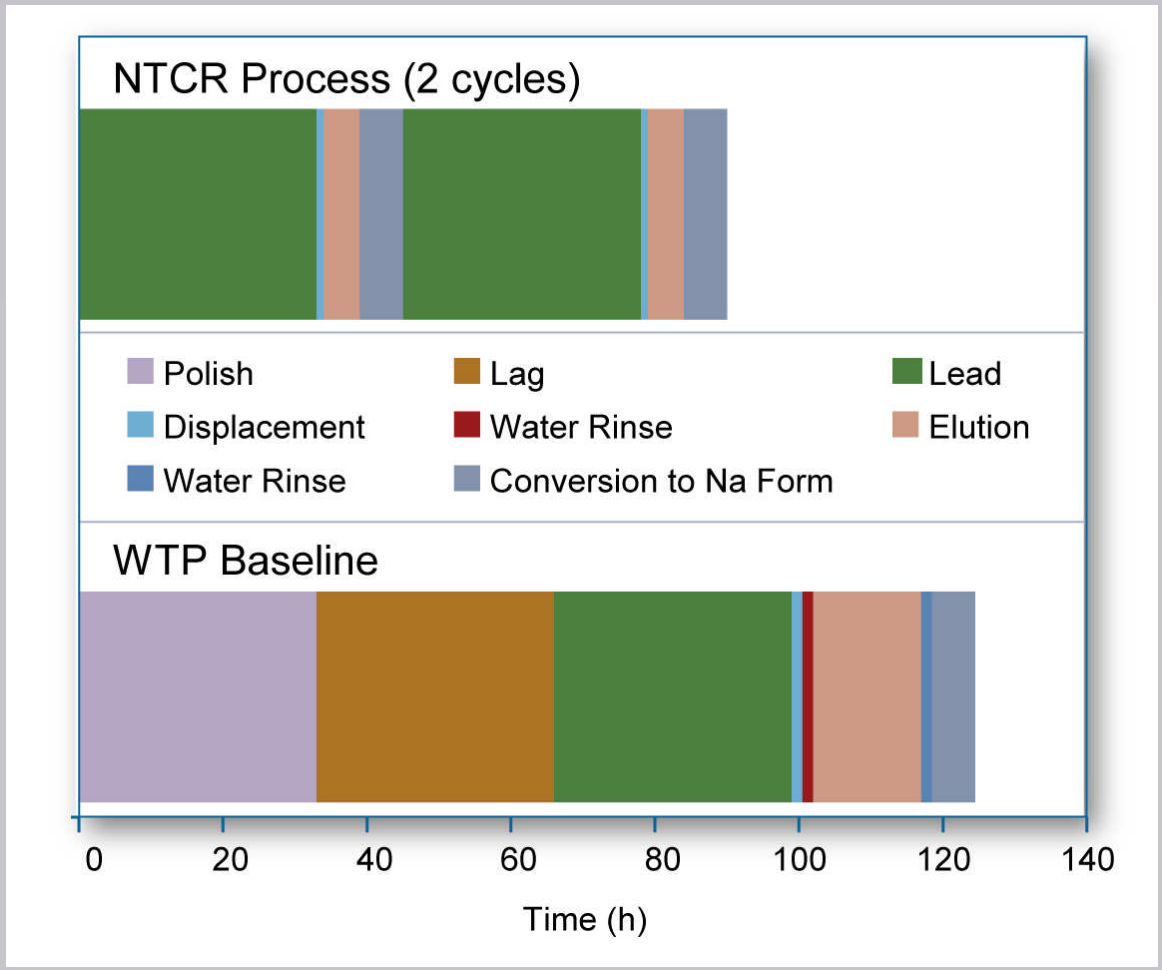
- Deployment of the NTCR process will:
  - Accelerate the start of WTP LAW Vitrification Facility up to 6 years freeing up DST space to accept SST retrieval waste
  - Supply feed to supplemental treatment (Bulk Vitrification)
- The NTCR process is an efficient, simple process:
  - Regenerable resins with a longer life
  - Readily deployable and mobile
  - Fixed lead/lag column configuration
  - In-situ spent resin destruction
- The NTCR process is based on extensive actual waste testing and deployment of proven technologies
- Full-Scale deployment does not require additional actual waste testing

Phase I Results

The NTCR process eliminates the handling of spent resin through the resin digestion process

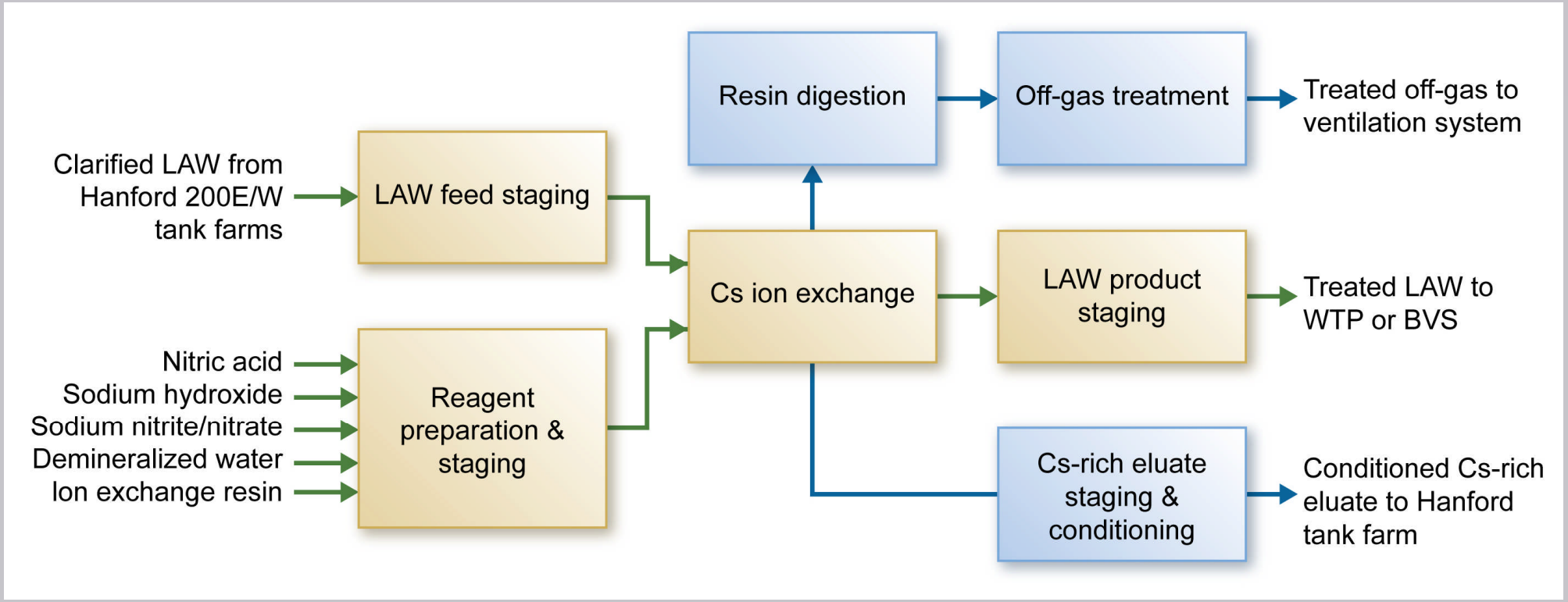


The NTCR processes uses a fixed lead-lag configuration to increase the time on line



Phase I Results

- Demonstration design basis is a 1/3-diameter, full height ion exchange column (87 liter) for cesium removal
- Designed to produce full scale decomposition reaction residence time
- Full height column will give full scale ion exchange performance
- Results can be applied directly to full scale field deployment unit with no need for additional actual waste testing



Phase II Objectives

Our Phase II work will demonstrate that NTCR:

- Provides effective Cesium (Cs) separation using a mobile, shielded system that can easily be deployed near Hanford tanks
- Extends resin life allowing more elutions than current ion exchange systems
- Simplifies the design relative to planned Waste Treatment Plant (WTP) Pretreatment Facility (PTF) ion exchange systems to provide improved ease of operation
- Allows dissolution and digestion of the resin to eliminate resin handling
- Easily interfaces with current and planned Hanford treatment facilities
- Complies with ES&H requirements established by the Maintenance and Operations (M&O) contractor
- Will allow DOE to close single shelled tanks (SSTs) early and free-up space in double shelled tanks (DSTs)

Phase II Planned Activities

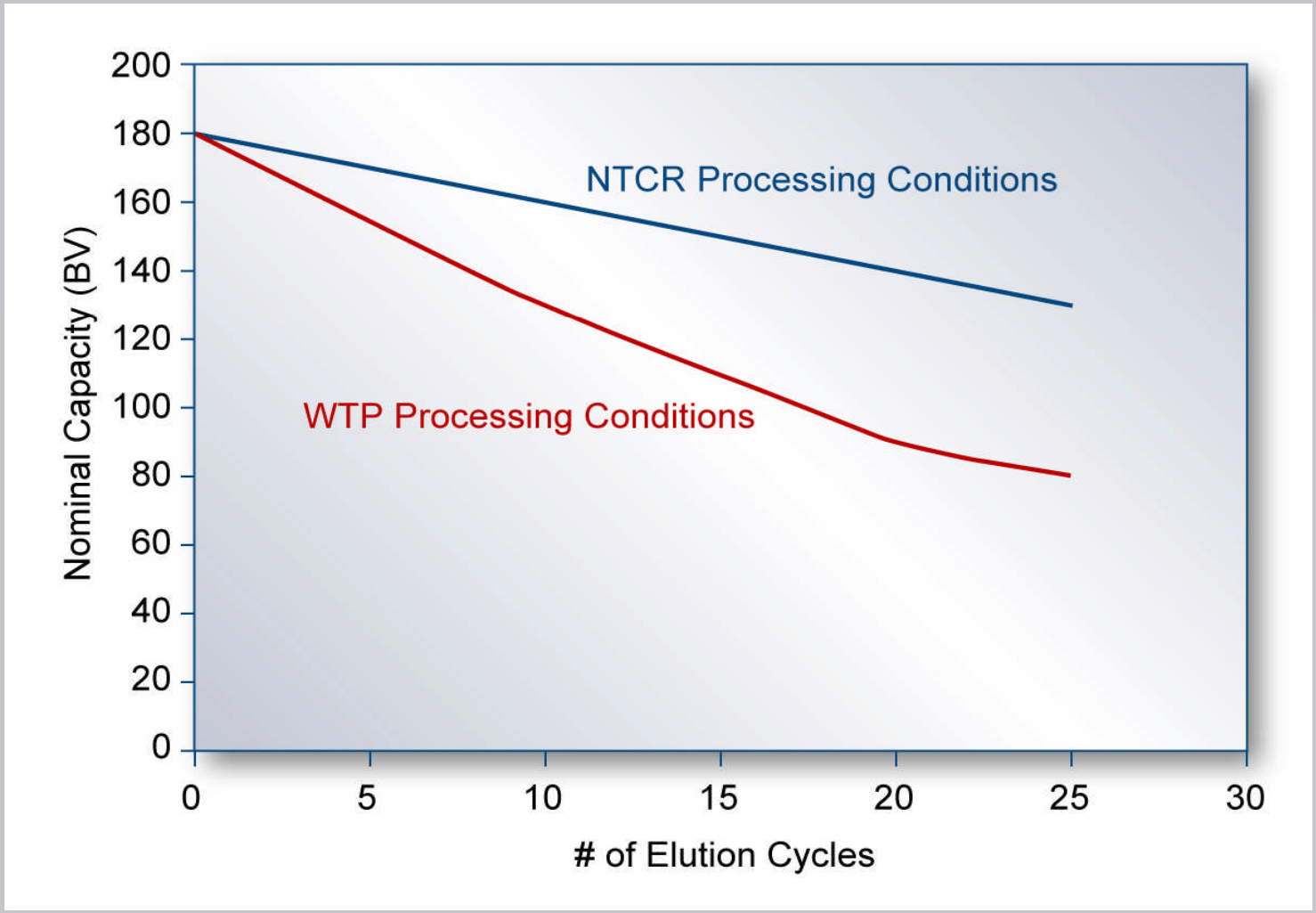
- Procure and construct demonstration unit
- Perform bench scale studies to optimize process performance
  - Batch resin dissolution and destruction process testing
    - Determine optimum process conditions for small-column resin destruction process
    - Provide initial characterization of nitric acid resin destruction residues (VOA/SVOA)
  - Small column resin dissolution testing
    - Determine process conditions for safe operation of pilot tests
    - Initial characterization of off-gas (NOx, VOC)
  - Small Column Ion Exchange Testing
    - Evaluate impact of feed variability on resin performance
    - Determine effect of lower than ambient temperature on elution of resin beds

Phase II Planned Activities

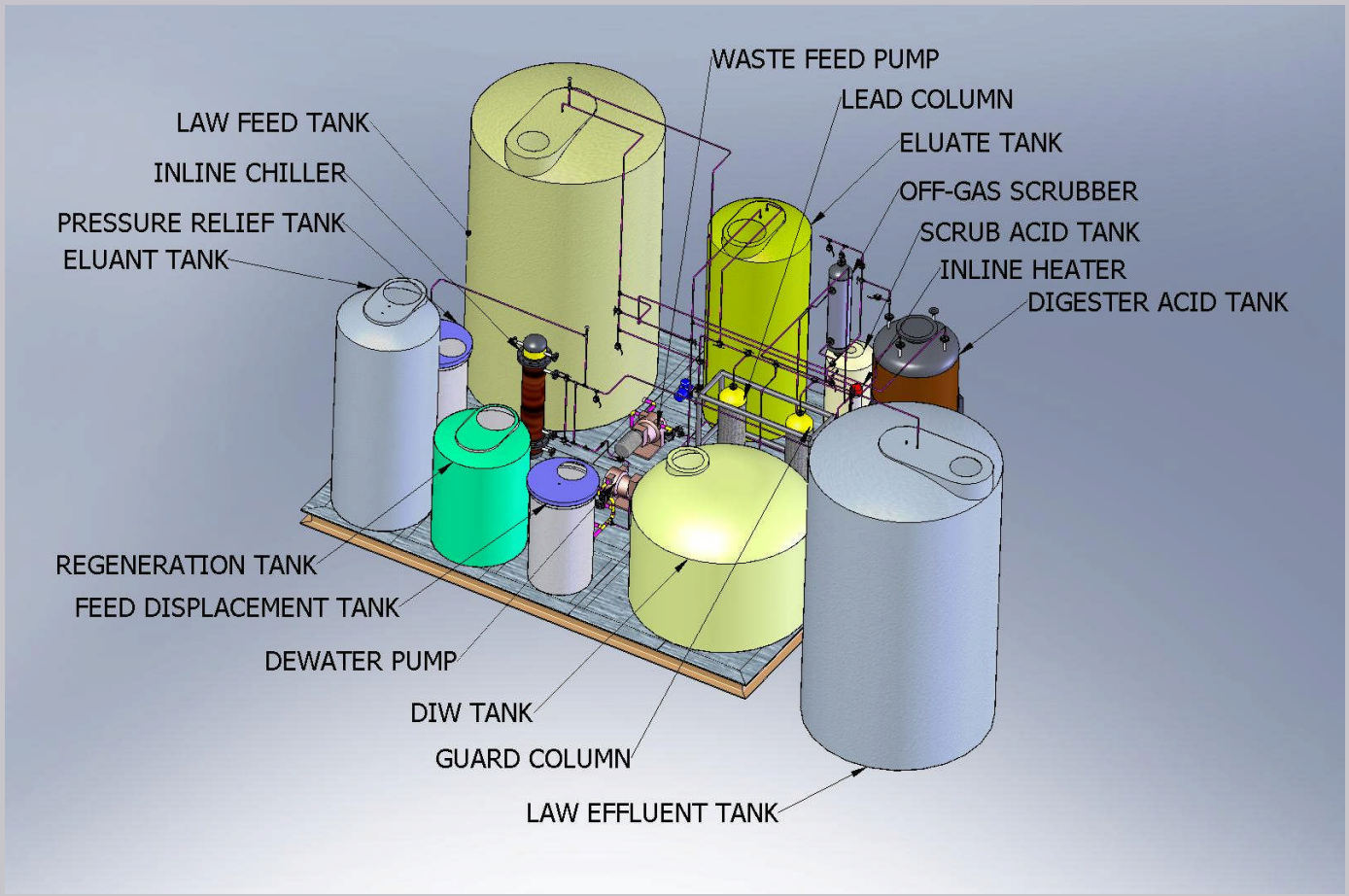
- Using bench scale results, perform demonstration unit testing (Pilot-Scale)
  - Ion Exchange Testing
    - Identify/demonstrate optimum and safe process conditions
    - Demonstrate optimum mode of operation
  - Resin destruction process testing
    - Identify and demonstrate optimum and safe process conditions
- Based on testing results, complete conceptual design and ROM cost/schedule for Phase III deployment

Phase II Expected Results

NTCR processing conditions will significantly extend the useable lifetime of the resin



Depiction of Pilot Unit



- NTCR uses a streamlined flowsheet which provides more on-line processing time
- Simpler design allows faster deployment

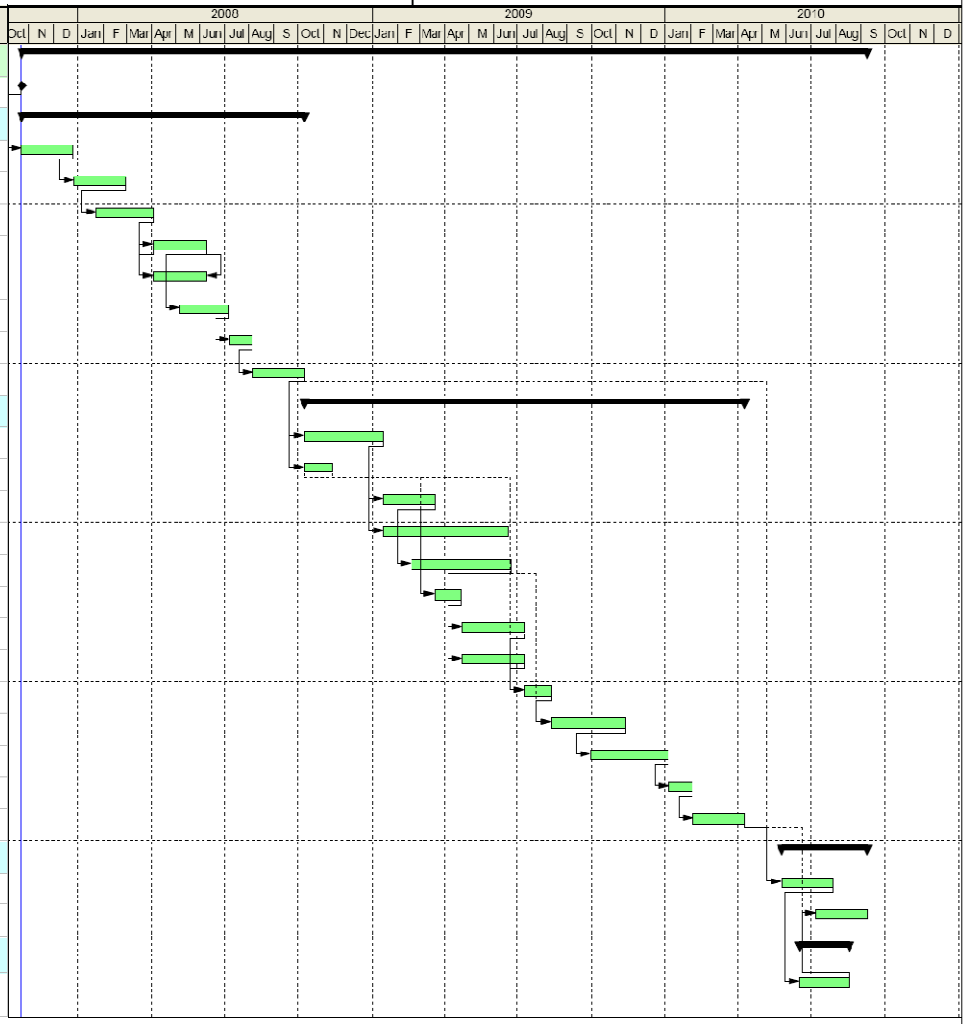
Phase II Test Program

- Identify and demonstrate optimum and safe process conditions:
  - Process stream flow rates
  - Process stream volumes
  - Process stream composition
  - Temperature and pressure
  - Characterize organics and off-gas sampling for NOx / VOA / VOC in process streams
  - Characterize reaction rate and extent of reaction

NTCR Phase II Schedule

Phase II Deployment | Classic WBS Layout | 16-Oct-07 16:57

Activity ID	Activity Name	Start	Finish
Phase II Deployment		23-Oct-07	09-Sep-10
A1040	Notice to Proceed	23-Oct-07	
Bench Scale Testing		23-Oct-07	08-Oct-08
A1000	Prepare Bench-Scale Test Plan	23-Oct-07	26-Dec-07
A1010	Procure Bench-scale Materials/Equipment	27-Dec-07	28-Feb-08
A1020	Fabricate/Assemble Bench-Scale Systems	24-Jan-08	03-Apr-08
A1050	Bench Scale Caustic Test	04-Apr-08	09-Jun-08
A1030	Bench Scale Filtration Test	04-Apr-08	09-Jun-08
A1060	Analyze Bench-Scale Sample Results	07-May-08	07-Jul-08
A1070	Evaluate Bench-Scale Test Data	08-Jul-08	05-Aug-08
A1080	Preapare Bench Scale Test Report	06-Aug-08	08-Oct-08
Pilot Demo Testing		09-Oct-08	09-Apr-10
A1100	Prepare Demo Test Plan	09-Oct-08	14-Jan-09
A1190	Revise Test Plan	09-Oct-08	12-Nov-08
A1110	Design Demo System	15-Jan-09	19-Mar-09
A1210	DOE Procure/Deliver Simulant	15-Jan-09	18-Jun-09
A1120	Procure Demo System Materials/Equipment	19-Feb-09	23-Jun-09
A1200	Revise Design	20-Mar-09	22-Apr-09
A1130	Fabricate/Assemble Demo System	23-Apr-09	09-Jul-09
A1250	Modify Demo System	23-Apr-09	09-Jul-09
A1140	Demo System Water Runs	10-Jul-09	11-Aug-09
A1150	Demo System Performance Tests	12-Aug-09	13-Nov-09
A1160	Analyze Sample Results	29-Sep-09	04-Jan-10
A1170	Evaluate Demo Test Data	05-Jan-10	04-Feb-10
A1180	Prepare Test Report	05-Feb-10	09-Apr-10
Phase III Deployment Conceptual Design & Cost & Schedule Estimate		25-May-10	09-Sep-10
A1220	Deployment System Conceptual Design	25-May-10	28-Jul-10
A1240	Prepare Phase II Project Completion Report	08-Jul-10	09-Sep-10
Phase III ROM Estimate		16-Jun-10	18-Aug-10
A1230	Prepare Phase III Deployment System Cost/Schedule ROM Estimate	16-Jun-10	18-Aug-10



Remaining Level of Effort | Actual Work | Actual Level of Effort | Remaining ...

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TASK filter: All Activities

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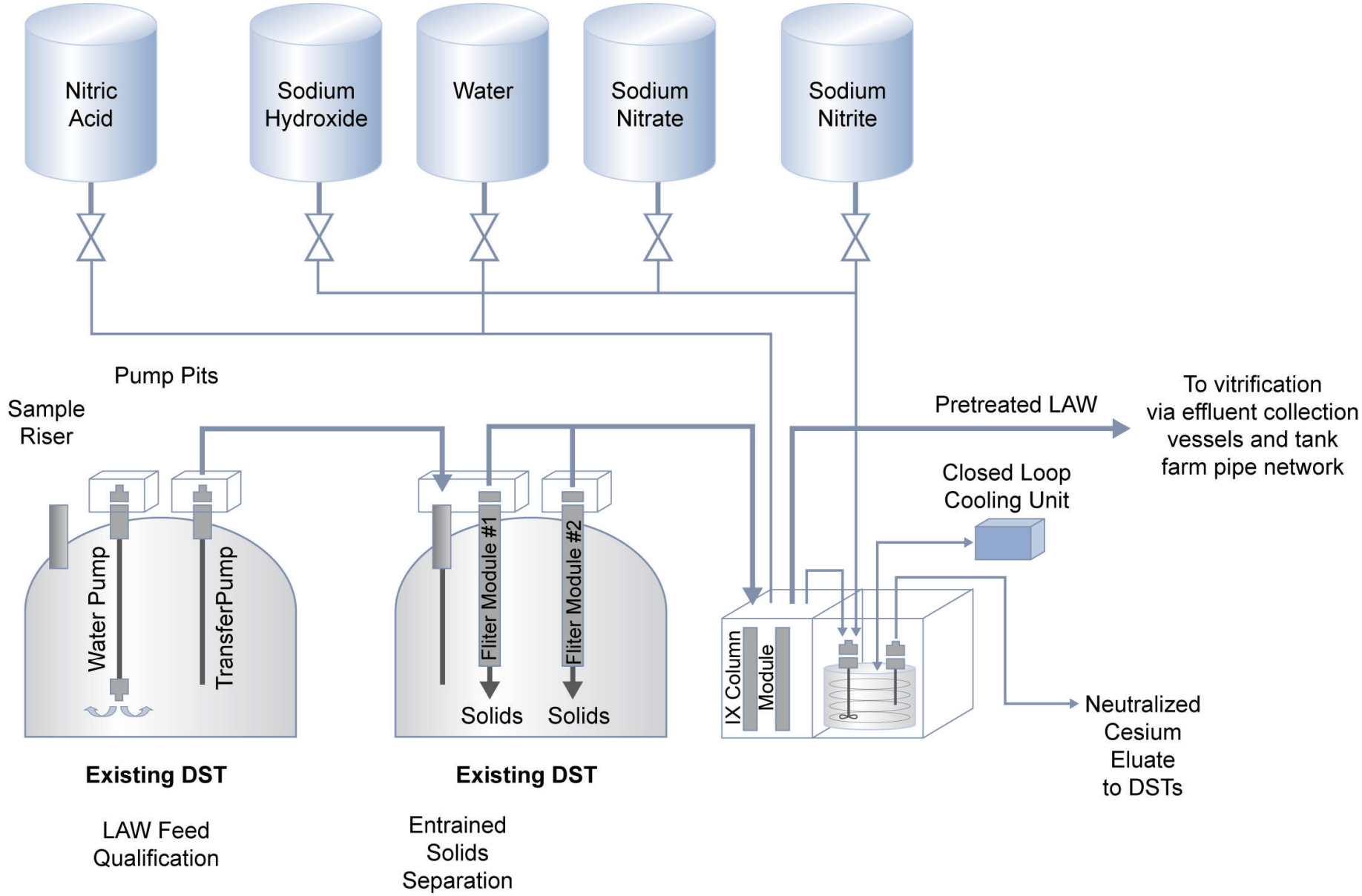
Phase II Schedule

Activity	***Start***
Bench-scale testing	October, 2007
Pilot Demonstration Unit Testing	October 2008
Deployment Engineering	May 2010
Deployment Cost Estimate and Schedule	June 2010

Phase III Full Field Deployment

- Current design basis is to produce 7 gpm of treated supernate to support WTP LAW vitrification
  - Design basis can be adjusted for supplemental treatment
- The NTCR would target treatment of the lower cesium waste
  - 200 East Area - AP and AN Tank Farms
  - 200 West Area – S and SX Tank Farms
- Resin digestion expected 1-2 times per year
  - Throughput is expected to be between 50 to 100 cycles before resin change out
- Field deployment will be completed within 60 months of Phase II award

Phase III 200 East Deployment

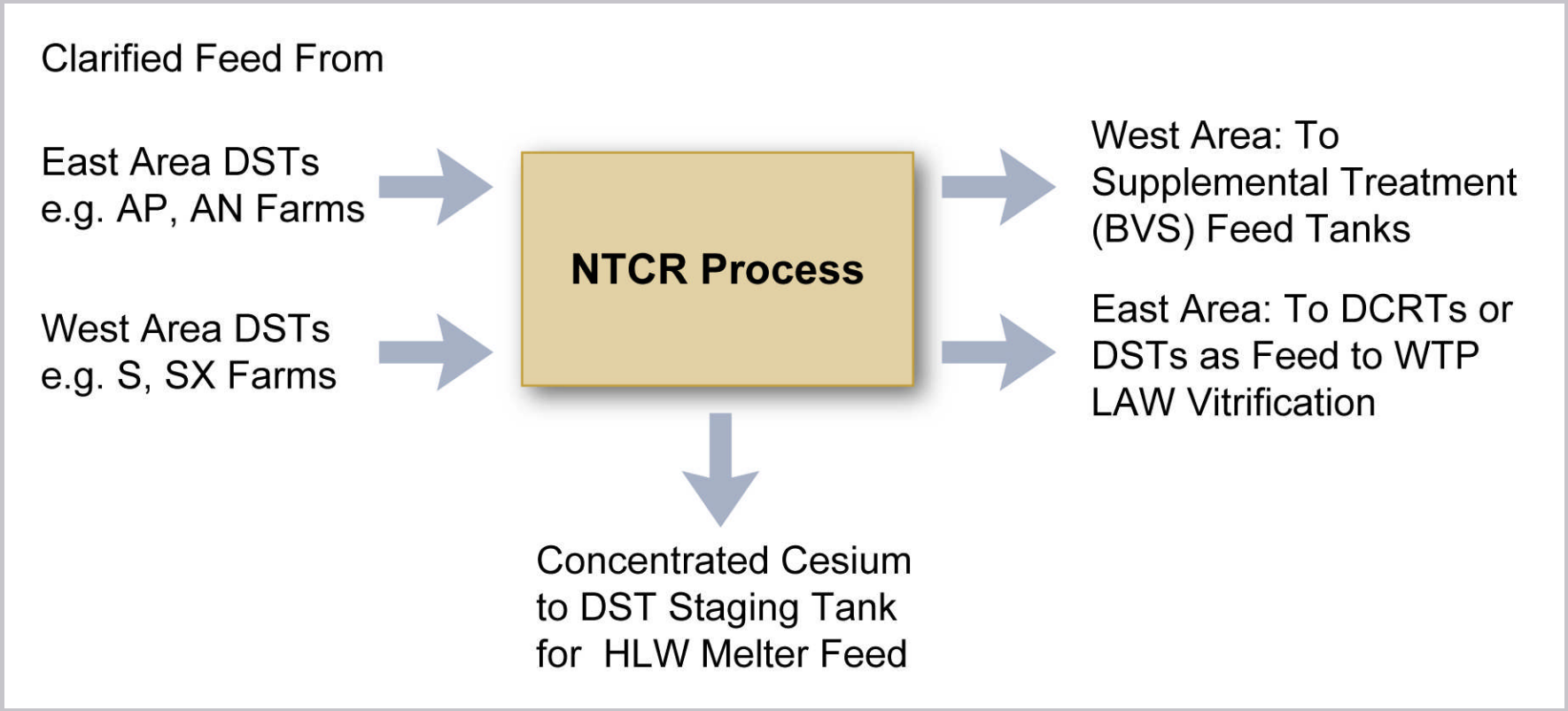


Ease of Deployment

- No new environmental permits will be required
- Uses existing “authorization basis”
- Meets all TFC requirements
- In-riser filtration (Spintek)
- Tie-in to existing pipelines or above-ground flexible waste transfer hose-in-hose
- Additional cesium decontaminated effluent storage may be needed

Ease of Deployment

The NTCR process can be deployed in support of a broad spectrum of processing options as part of the Hanford clean-up mission



Facility Interaction

- The NTCR process does not introduce any new hazards to the site
  - Uses chemicals currently used at site
  - Reduces quantity of tank waste material at risk relative to process baseline
  - Small size allows implementation of active safety controls
- The NTCR process can be integrated into the existing waste retrieval/treatment plans for the Hanford tank waste mission

Facility Interaction

Two locations have been identified for deployment of the NTCR.

- The first location is the 200 East area that would supply cesium decontaminated feed to the LAW vitrification facility.
- The other location is in the 200 West Area and would supply cesium decontaminated feed to supplemental treatment (Bulk Vitrification Facility).

NTCR Process Features

- Small footprint - process module designed for mobility
- All components that contact radioactive waste will be contained within a shielded module
- All chemical feed tanks located outside of shielded module for ease of maintenance.
- LAW feed, eluate, LAW effluent and digester tanks double walled with leak detection

NTCR Features

The NTCR process:

- Uses resin digestion to avoid spent resin handling
- Is based on extensive prior testing and proven technology
- Uses a fixed lead-lag configuration to minimize the valving requirements
- Uses advanced resin media and cool nitric acid for elution
- Uses heated nitric acid for resin digestion

These are significant process improvements over the baseline ion exchange technology.

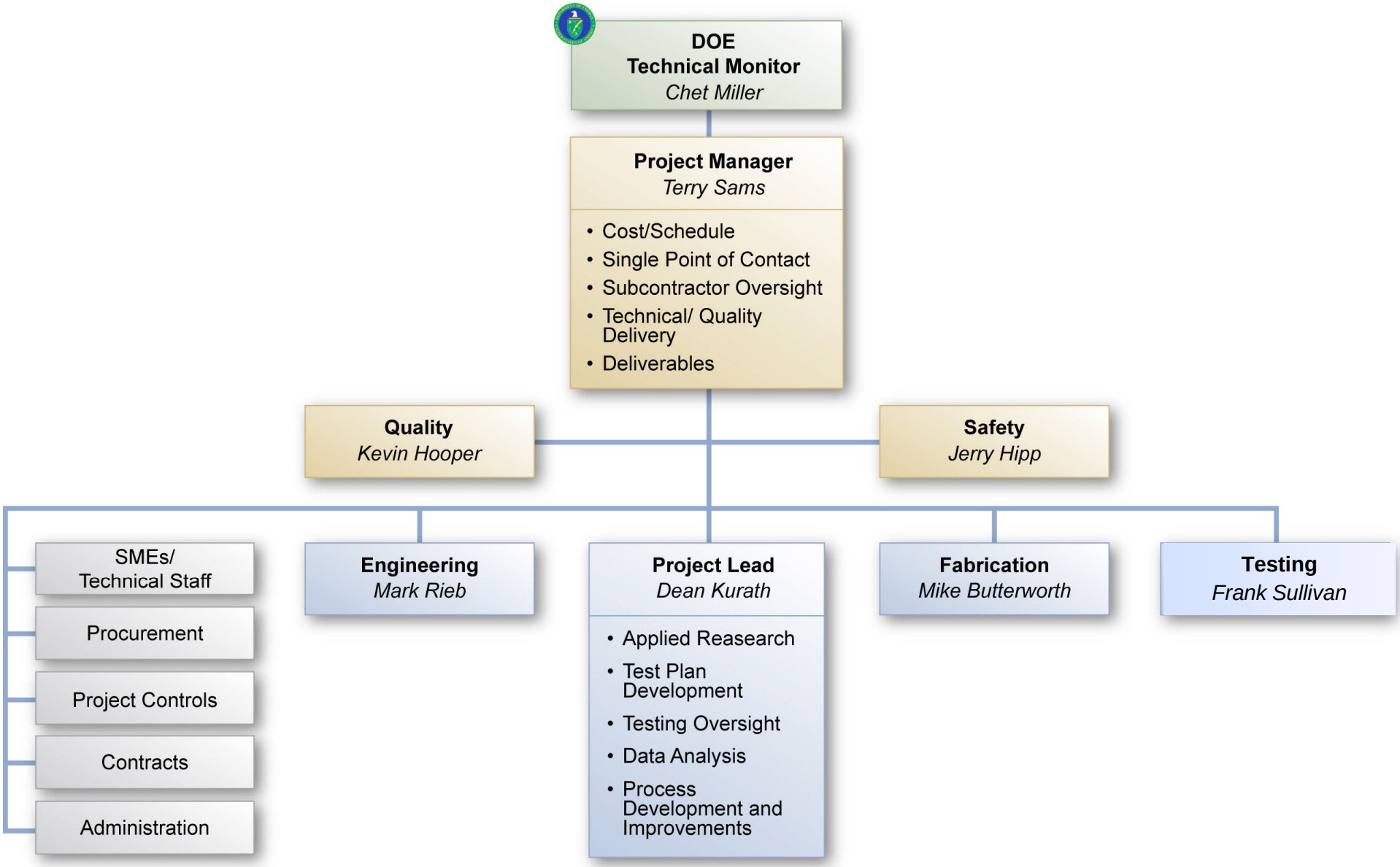
NTCR Advantages

Deficiency of Current Technology	Feasibility of Proposed Technology to Overcome	Innovation and Benefits
Additional LAW treatment required to supplement WTP	Allows LAW stream to go to supplemental treatment (e.g., bulk vitrification)	Increased treatment throughput Faster tank closure
Current IX approach uses four columns	Uses two columns in a fixed lead/lag position	Ease of maintenance Lower cost Reduced footprint
Generates a secondary waste steam of spent IX resin	Resin soluble in mild nitric acid solution at elevated temperature – flushed solution can be vitrified or sent to DSTs for interim storage	Treatment started sooner Accelerated tank closure
Driven by WTP schedule – may delay tanks closure	Allows earlier treatment (up to 6 years)	Frees up tank space
Shard resin develops fines and requires frequent intervention to remove fines	Proposed technology is a bead resin, which does not behave in this manner	Simplified operation and longer resin life

Team Experience

- The Parsons team has extensive experience with all aspects of the demonstration and deployment of the NTCR process
- Parsons experience with SWPF and chemical demilitarization programs has demonstrated the ability to deploy technology for treatment of highly hazardous and radioactive wastes
- Battelle has extensive experience in planning and managing bench and pilot scale demonstration for HLW treatment technologies including NTCR
- Both the Project Manager and the Project Lead have extensive experience with Hanford tanks and separation technology experience

Organization



Summary and Conclusions

- The NTCR process is based on extensive experimental data and the deployment of proven technologies
- Deployment of the NTCR process could accelerate the start of WTP LAW Vitrification Facility up to 6 years
- Deployment of the NTCR process will supply feed to supplemental treatment (bulk vitrification)
- Processing of this tank waste early will:
  - Free up DST space which will allow additional SST retrieval to proceed
  - Demonstrate progress on tank waste treatment, independent of the schedule for the WTP Pretreatment Facility completion date
  - Accelerate Tank Farm Closure
- Full-Scale deployment does not require additional actual waste testing

Summary and Conclusions

- Rapid deployment is made possible by:
  - Modular, mobile design concept based on a simplified process
  - Proven technology based on extensive testing results
  - Fixed lead/lag configuration
  - Fewer processing steps
  - Elimination of spent resin as a solid waste stream
  - Simplified NTCR decommissioning compared to a fixed facility for Cs ion exchange
  - Minimization of resin-related wastes by extending resin life