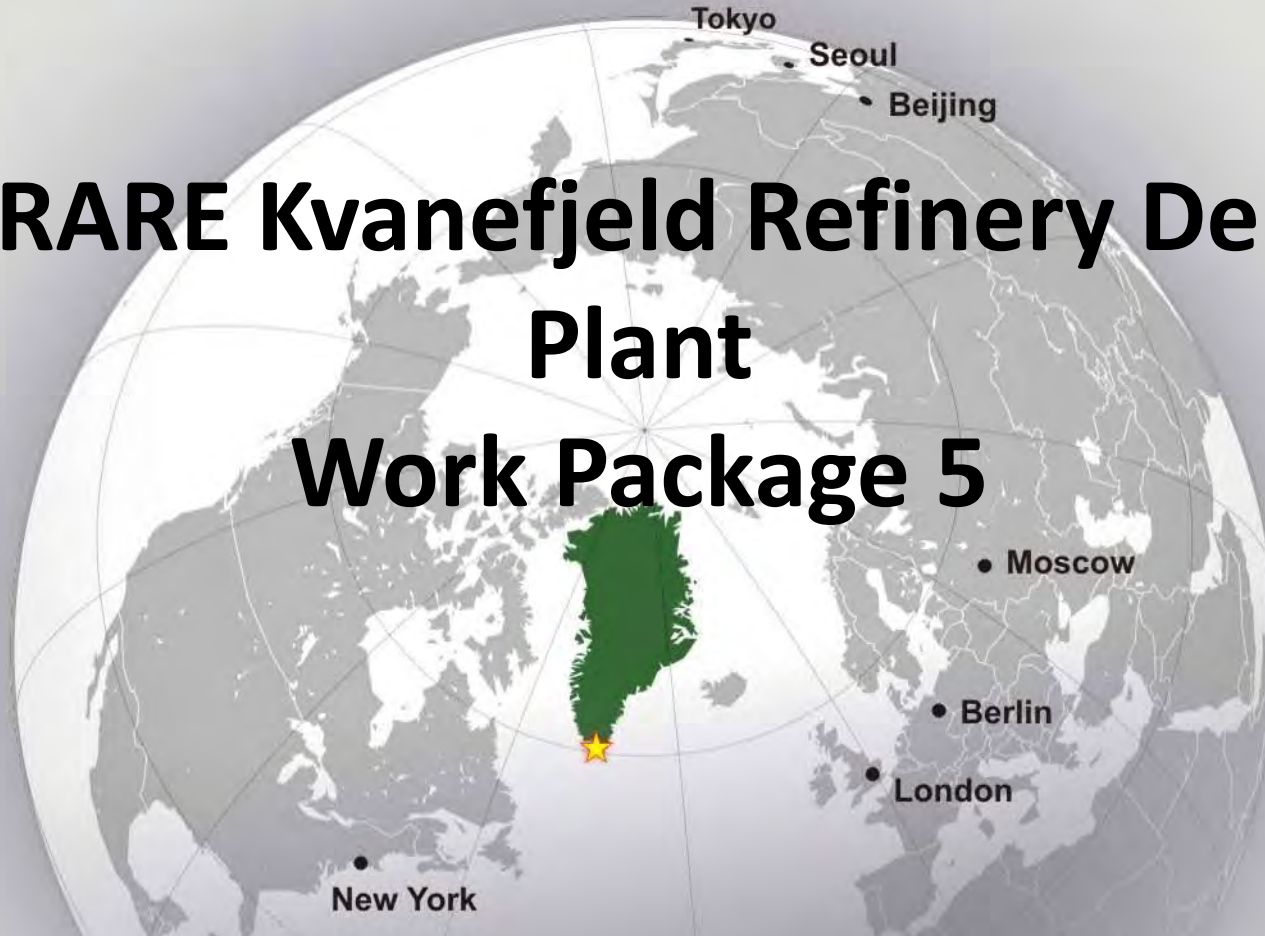




GREENLAND
MINERALS AND ENERGY LTD

EURARE Kvanefjeld Refinery Demo Plant Work Package 5



eu

57-71

Rare

sustainable exploitation

Strategic Metals For Global Industry

www.ggg.gl

October 2015

About Outotec Research Laboratories

Highly Skilled and Experienced in Atmospheric Leaching

Outotec



- Located in Pori, Finland
- Part of Outotec Global Metallurgy
- Highly skilled and experienced in atmospheric leaching
- Developed the HydroCu process
- Hydrometallurgical expertise
- State of the art facilities



Outotec Research Laboratories

Entrance to Outotec Research Laboratories

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About the Refinery Pilot Plant

250 kilograms of concentrated treated

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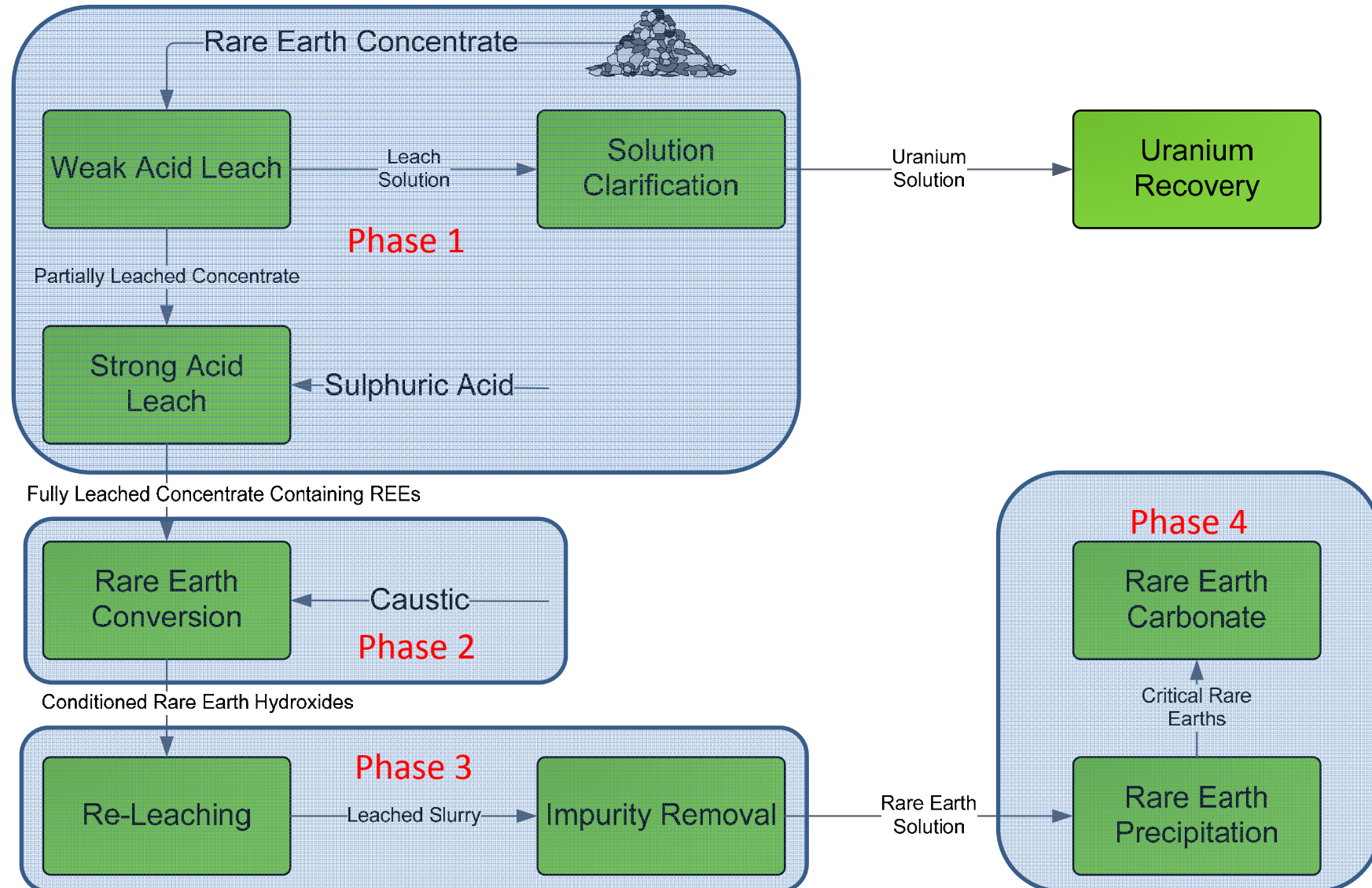
- 1st Kvanefjeld Refinery Pilot Plant Performed
 - Previously completed 100 hour continuous leaches
- Concentrate from 26 tonne flotation pilot plant in May 2015
- Fully integrated two stage leach
- Part of the EURARE Program
 - The EURARE program aims to encourage the sustainable supply of EU rare earth raw materials.



Pilot Plant Flowsheet

Process Piloted in Four Phases

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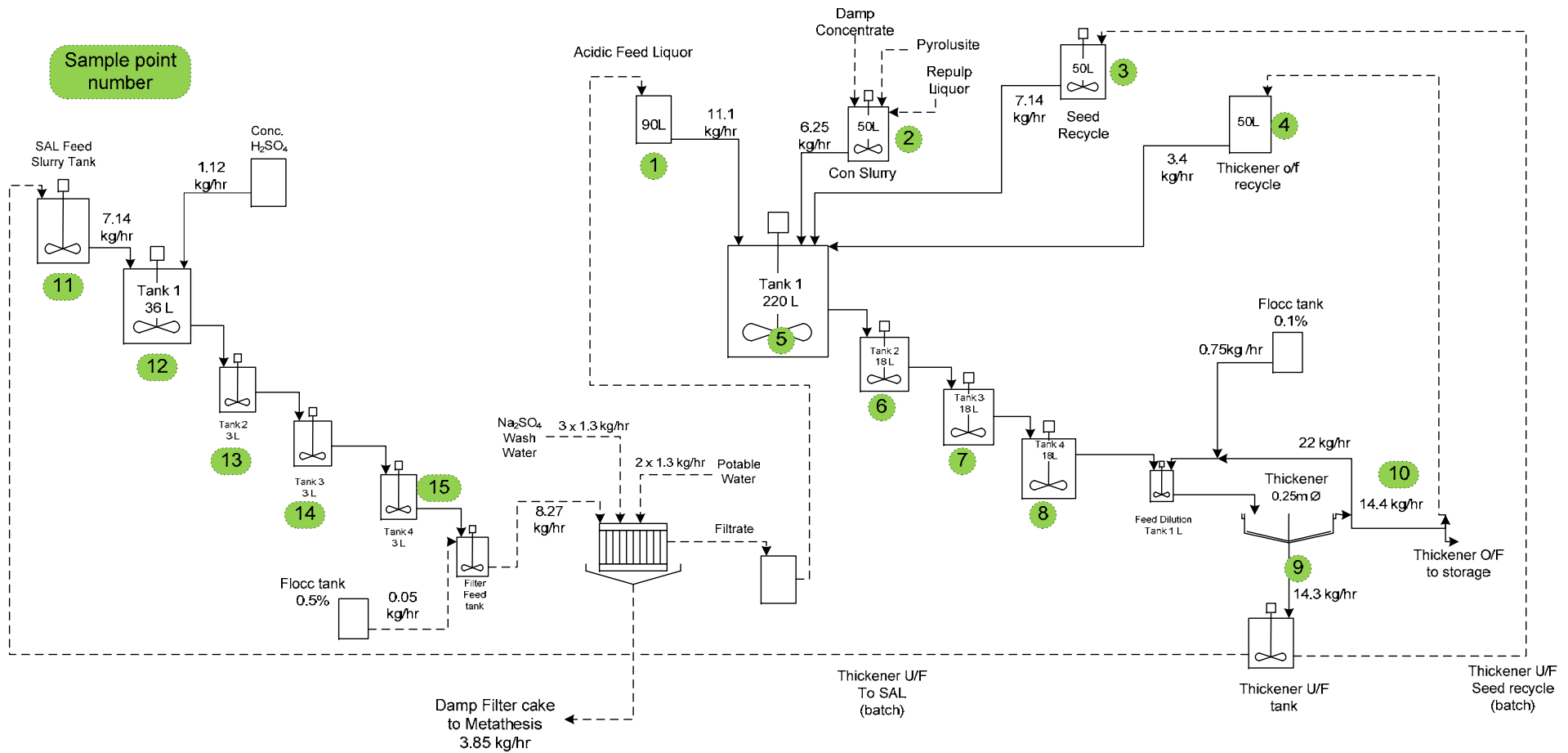


Pilot Plant Flowsheet Phase 1

Counter Current Atmospheric Leach with Two Products

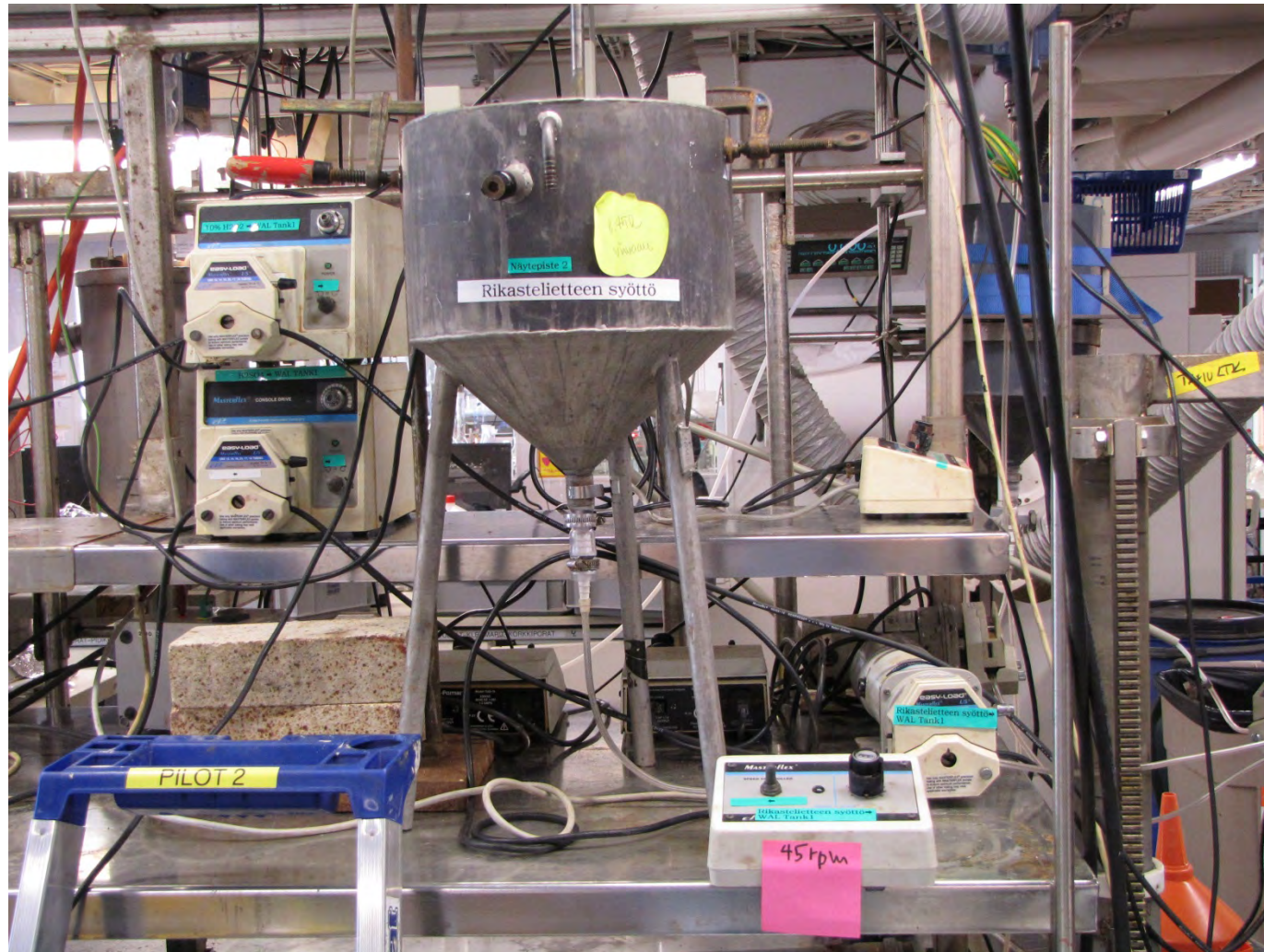


Two Stage Counter Current Leach Circuit



Concentrate Storage

Process Piloted in Three Phases



Weak Acid Leach Tank 1

Large Tank Used to assess scale and seeding

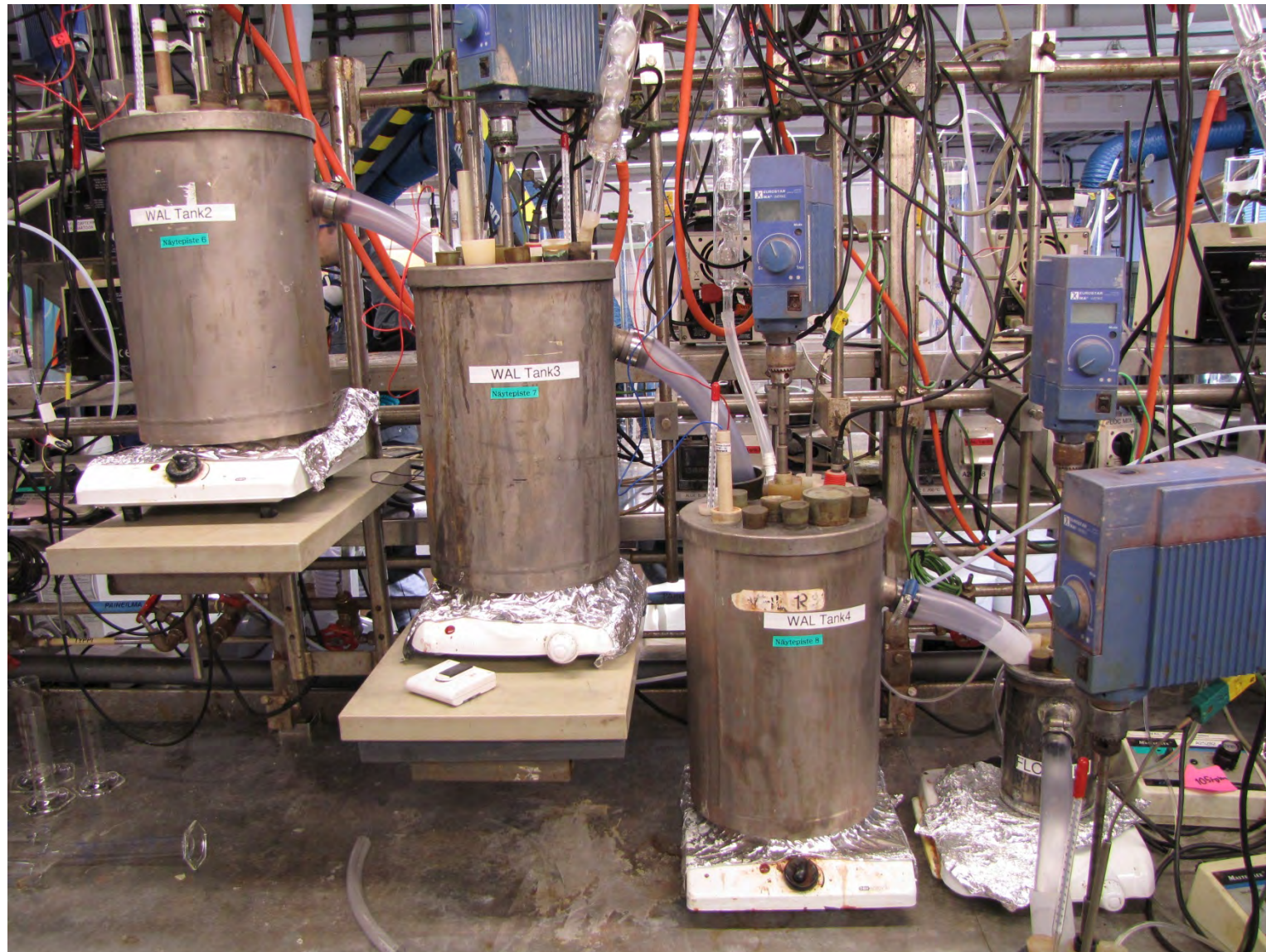
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Weak Acid Leach Circuit

Continuously Stirred Tank Reactors

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Weak Acid Leach Thickener

Clear Overflows Produced suitable for downstream

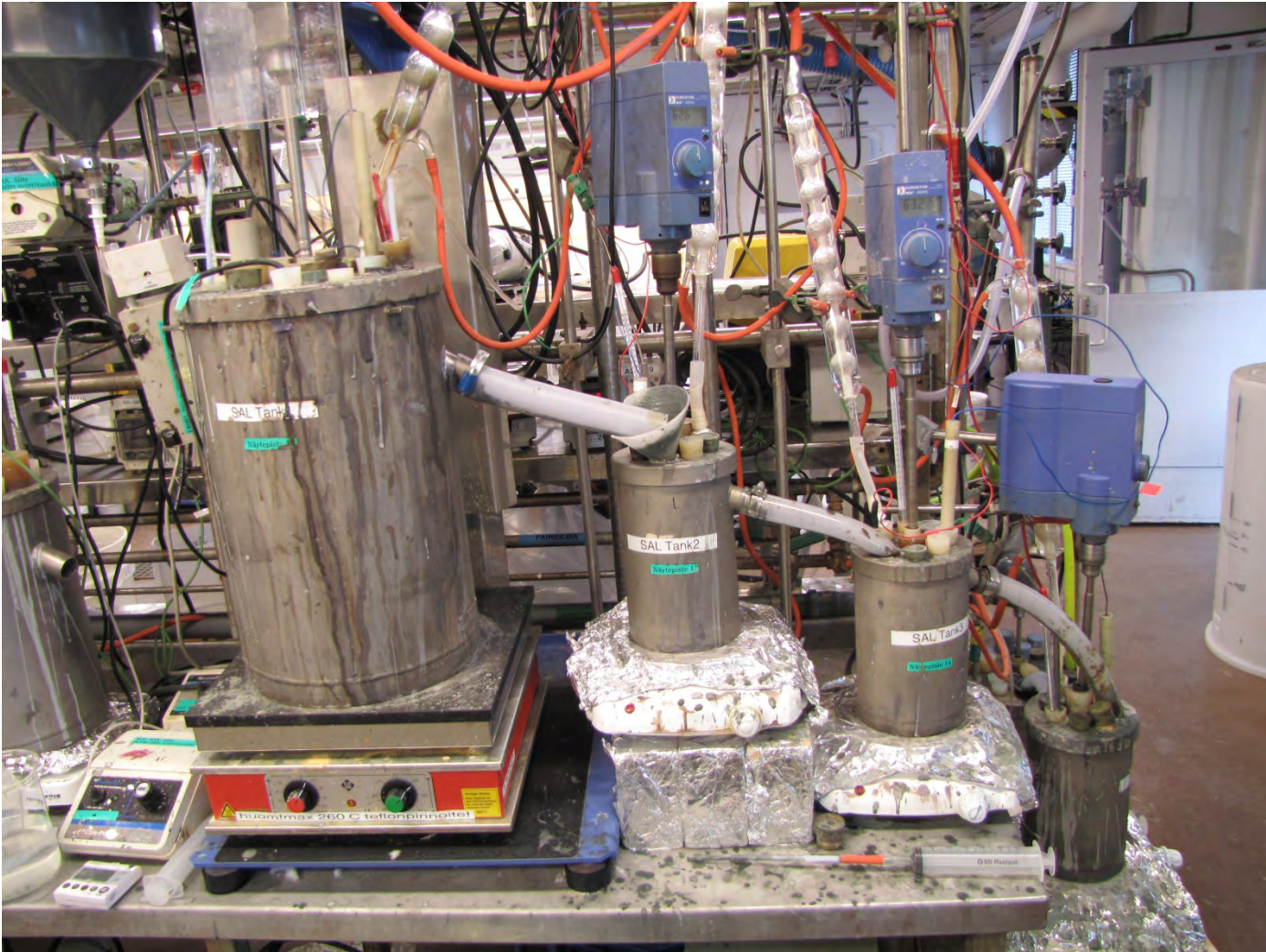
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Strong Acid Leach Circuit

Ensures High Extractions of Rare Earths and Uranium

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Strong Acid Leach Filtration

Good Filtration Observed for SAL Leach Discharge



Strong Acid Leach Filter Cake

Rare Earths in Filter Cake Ready for Next Phase ... Metathesis

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WAL Thickener Over Flow

Low Grade Uranium Solution Ready for Solvent Extraction

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Pilot Plant Facilities

Great Facilities and long 250 hours of operation

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- Computer Controlled
- Operated from Monday 31st August till Friday 11th of September



Overall Performance

Kvanefjeld Flotation Now Well Tested

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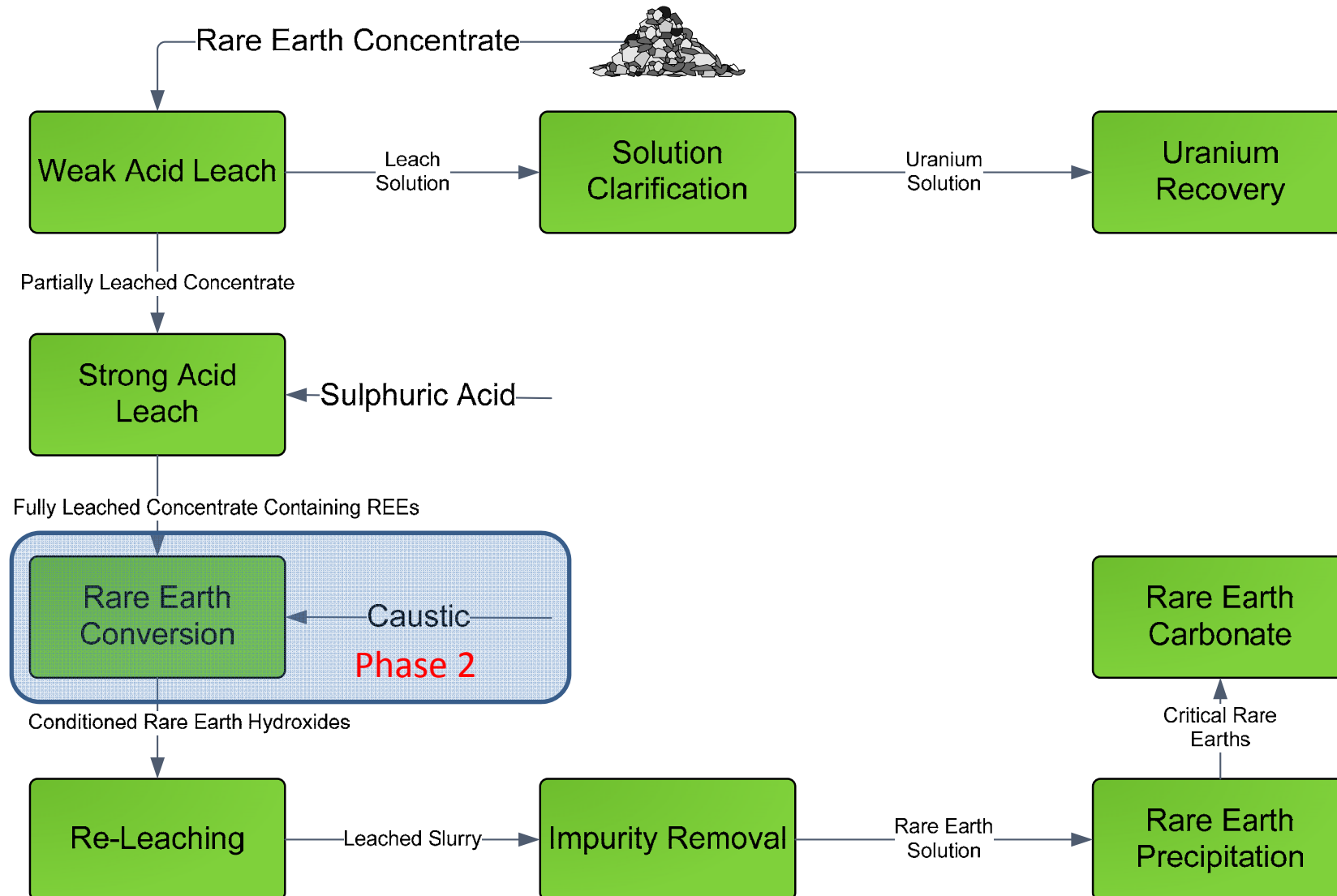


- High availability with only 4 hours of downtime
- Rare earth leach extraction of ~95%
 - Exceeding Feasibility Design of 77%
- Uranium leach extractions of ~85%
- Good circuit operability
- Silica control effective with no gelling
- Filtration and Thickening working well

Pilot Plant Flowsheet

Phase 2 Testwork

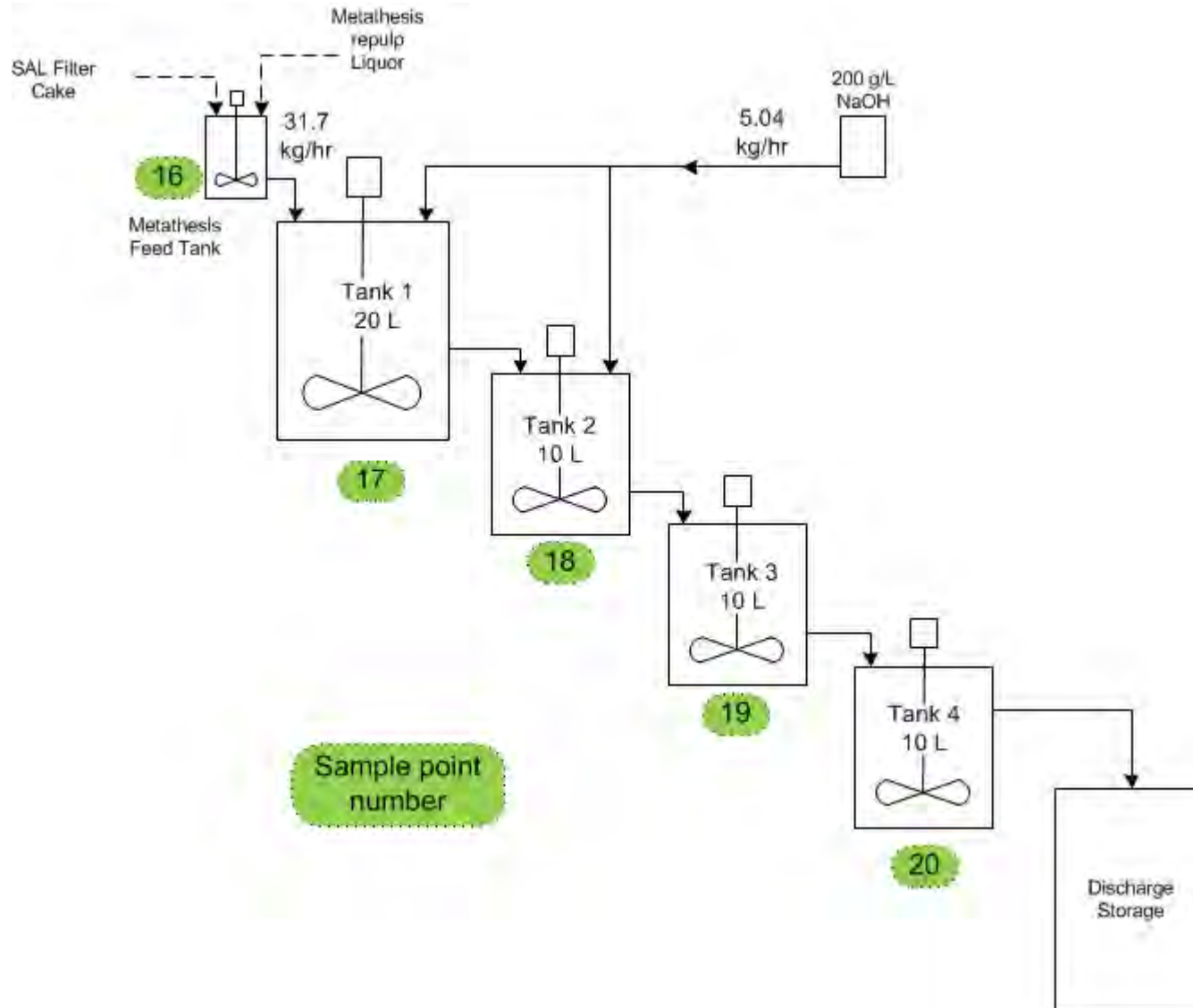
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Pilot Plant Flowsheet Phase 2

Metathesis – Rare Earth Double Sulphate Conversion

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Feed Storage

Re-pulped SAL Leach Residue

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Metathesis Cascade

Converting REE Double Salt to REE Hydroxide

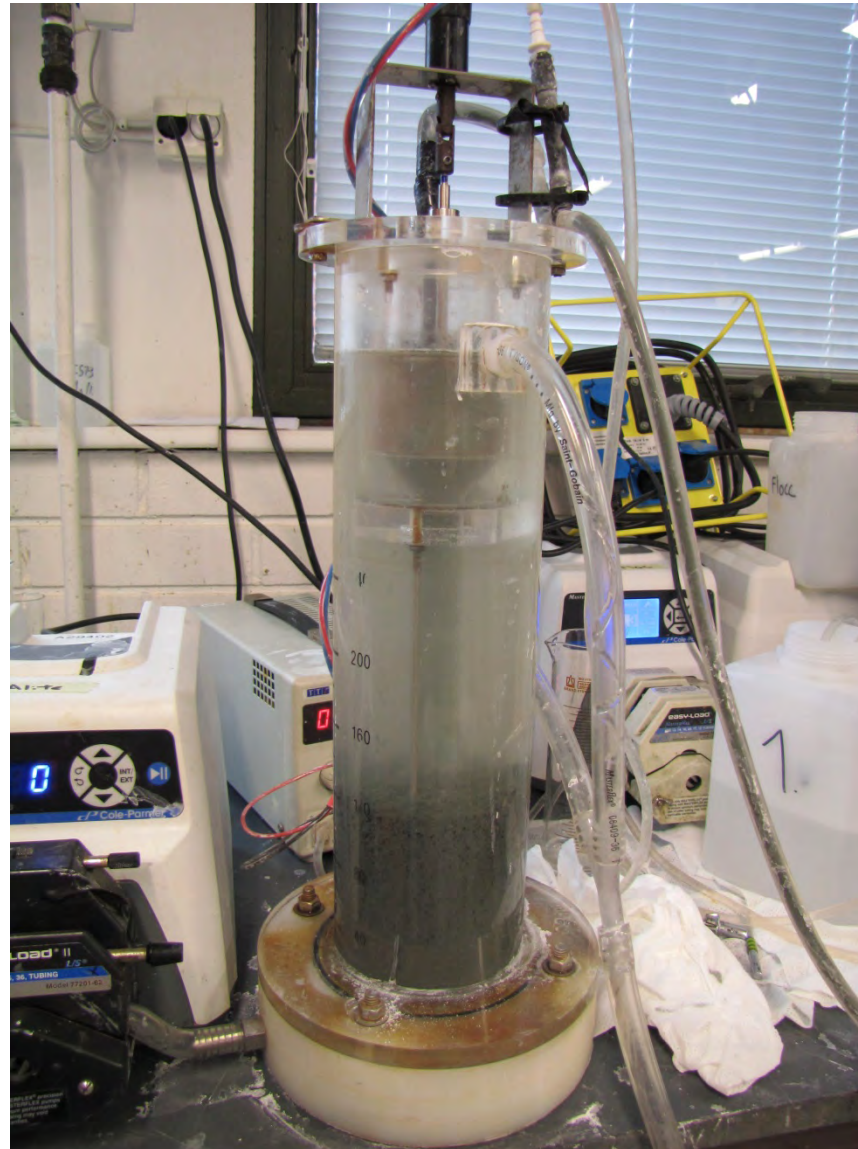
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Product Thickening

Dynamic Settling Tests for Thickener Sizing

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Metathesis Residues Filtration

Filtration and Washing Data Generated.

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Overall Performance

Metathesis Demonstrated Continuously

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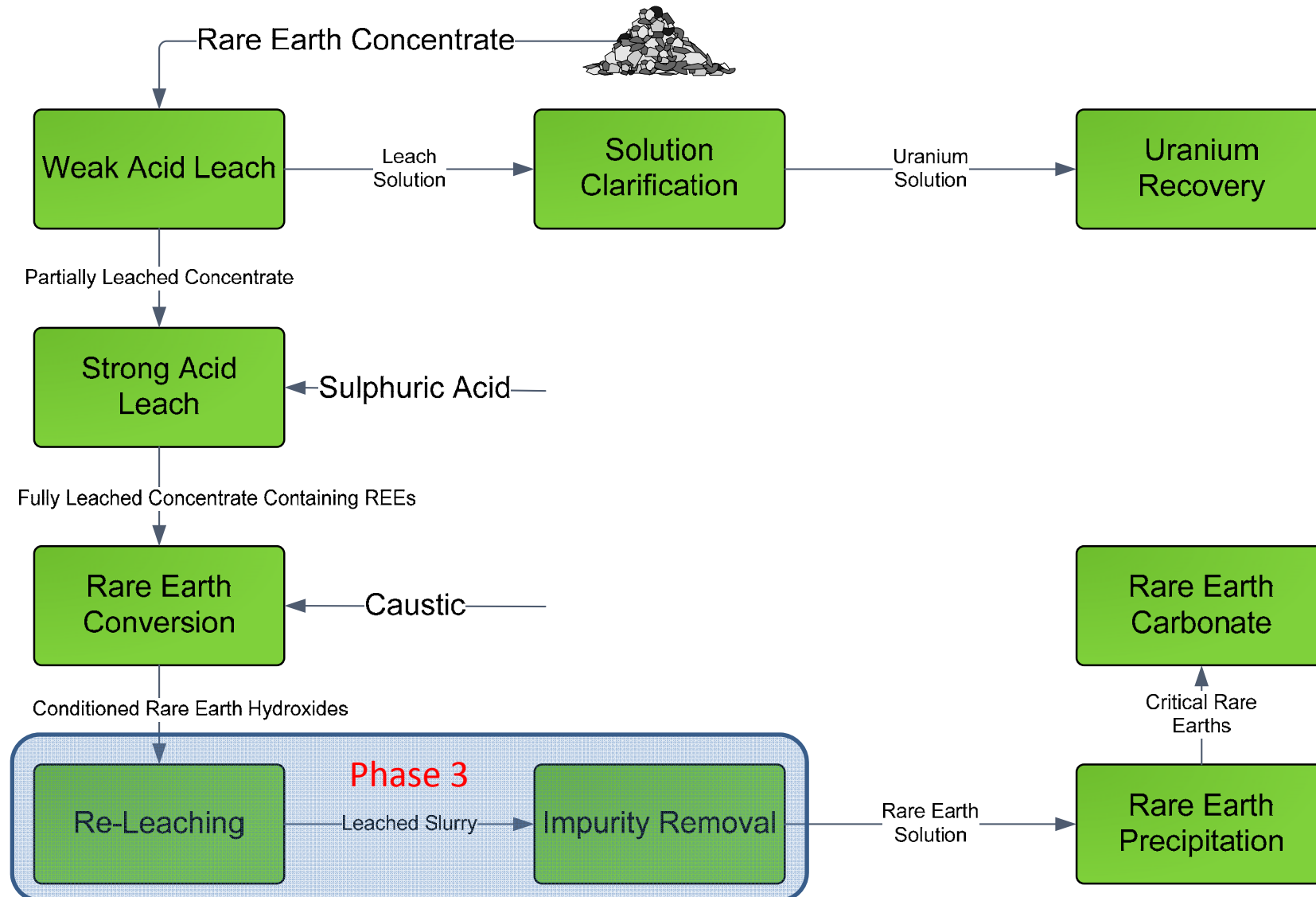


- High availability, no downtime
- Extensive double salt conversion achieved
- No requirement to heat circuit confirmed
- Good circuit operability
- Thickening and filtration working well

Pilot Plant Flowsheet

Phase 3

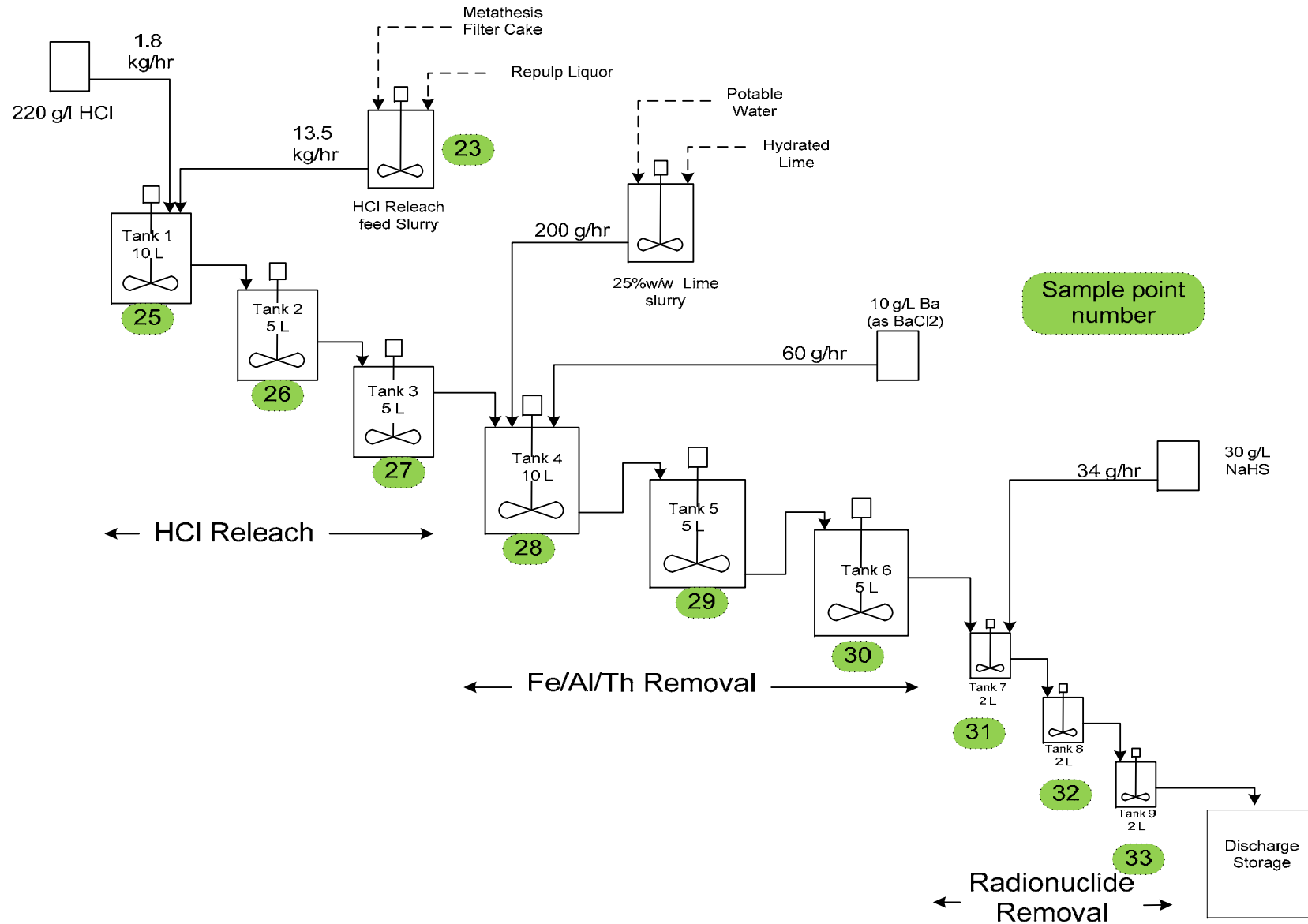
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Pilot Plant Flowsheet Phase 3

HCl Releach and Impurity Removal

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Feed Storage

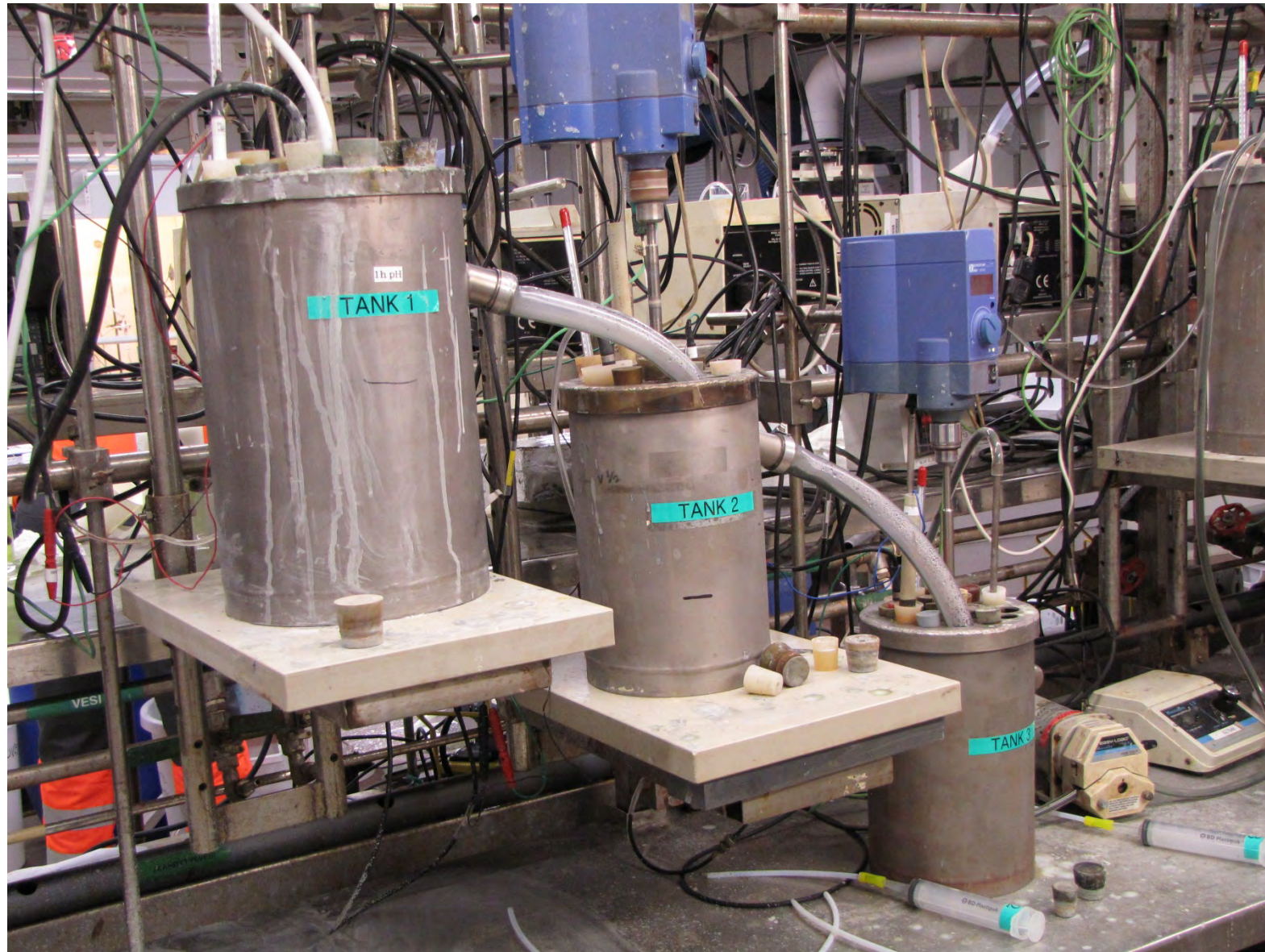
Re-pulped Metathesis Residue



HCl Release

Rare Earths Dissolved with HCl

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Impurity Removal

Fe / Al / Th Precipitated from Solution

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Radionuclide Removal

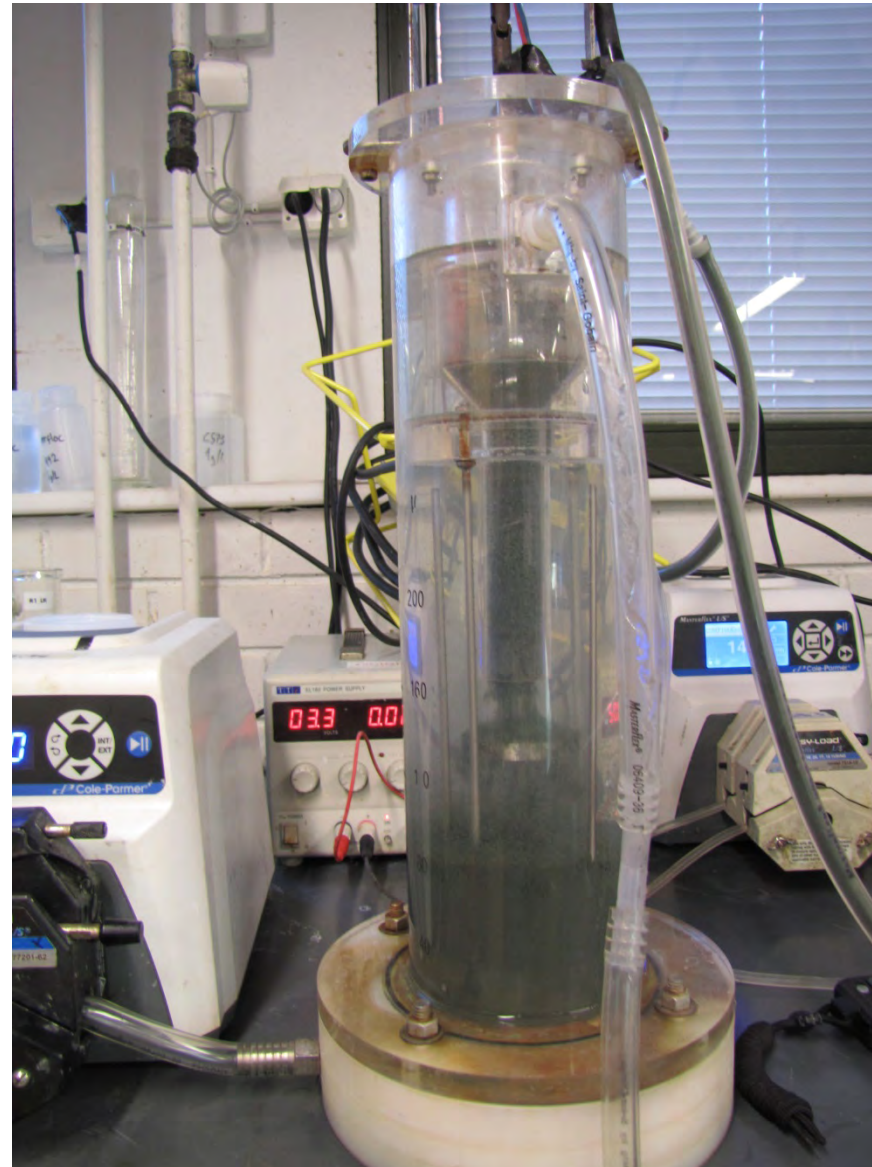
Pb / Po / Ra Precipitated from Solution

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Solid/Liquid Separation

Dynamic Thickener Testwork



Final Residues

Barren Residues for Disposal

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Overall Performance

Phase 3

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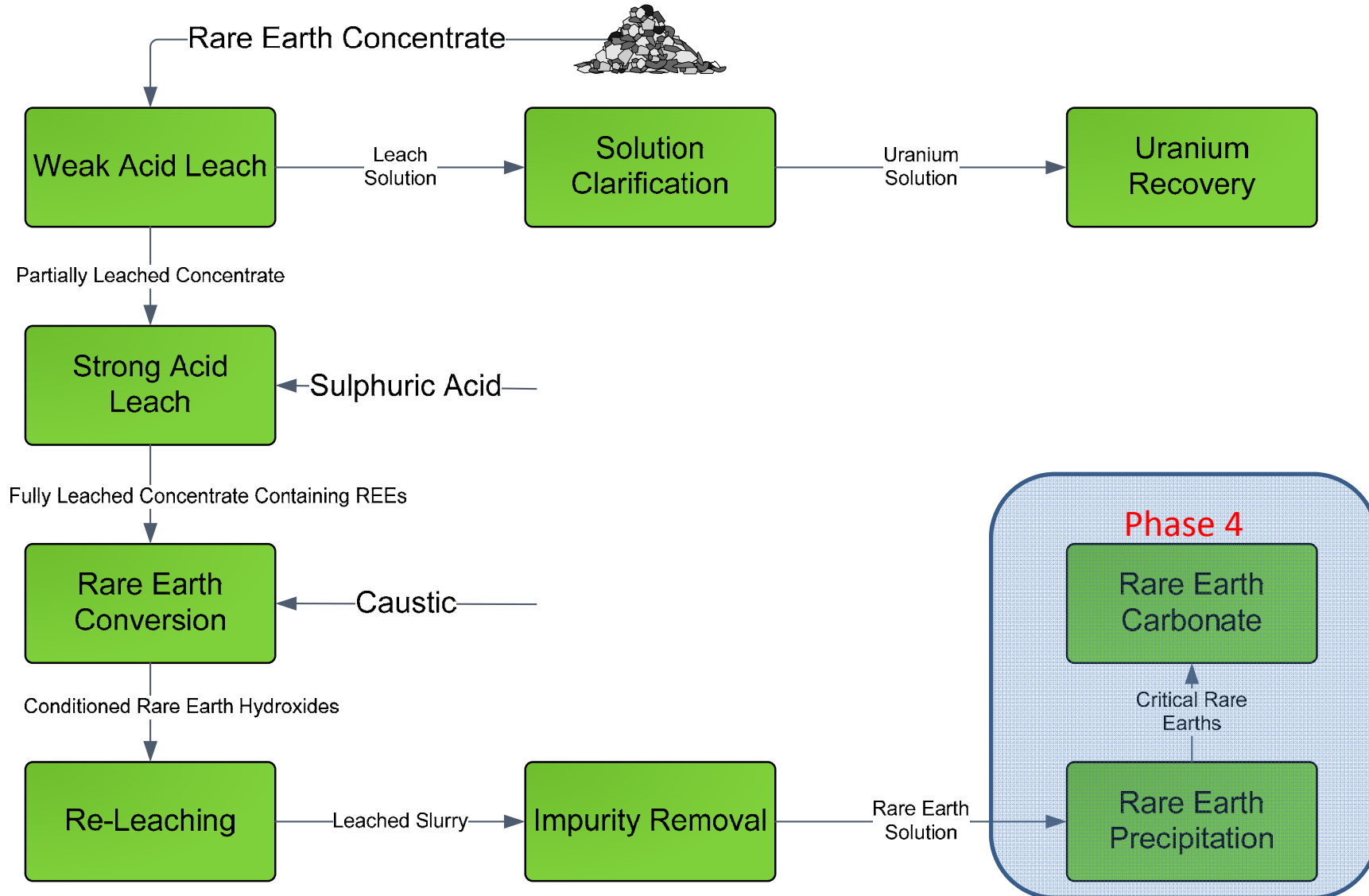


- High availability, no downtime
- Rare earth recovery from converted double salt >95%
- Low iron and aluminium dissolution in HCl leach
- High rejection of impurities.
- No requirement to heat circuit confirmed
- Good circuit operability
- Thickening achieved good underflow density and overflow clarity

Pilot Plant Flowsheet

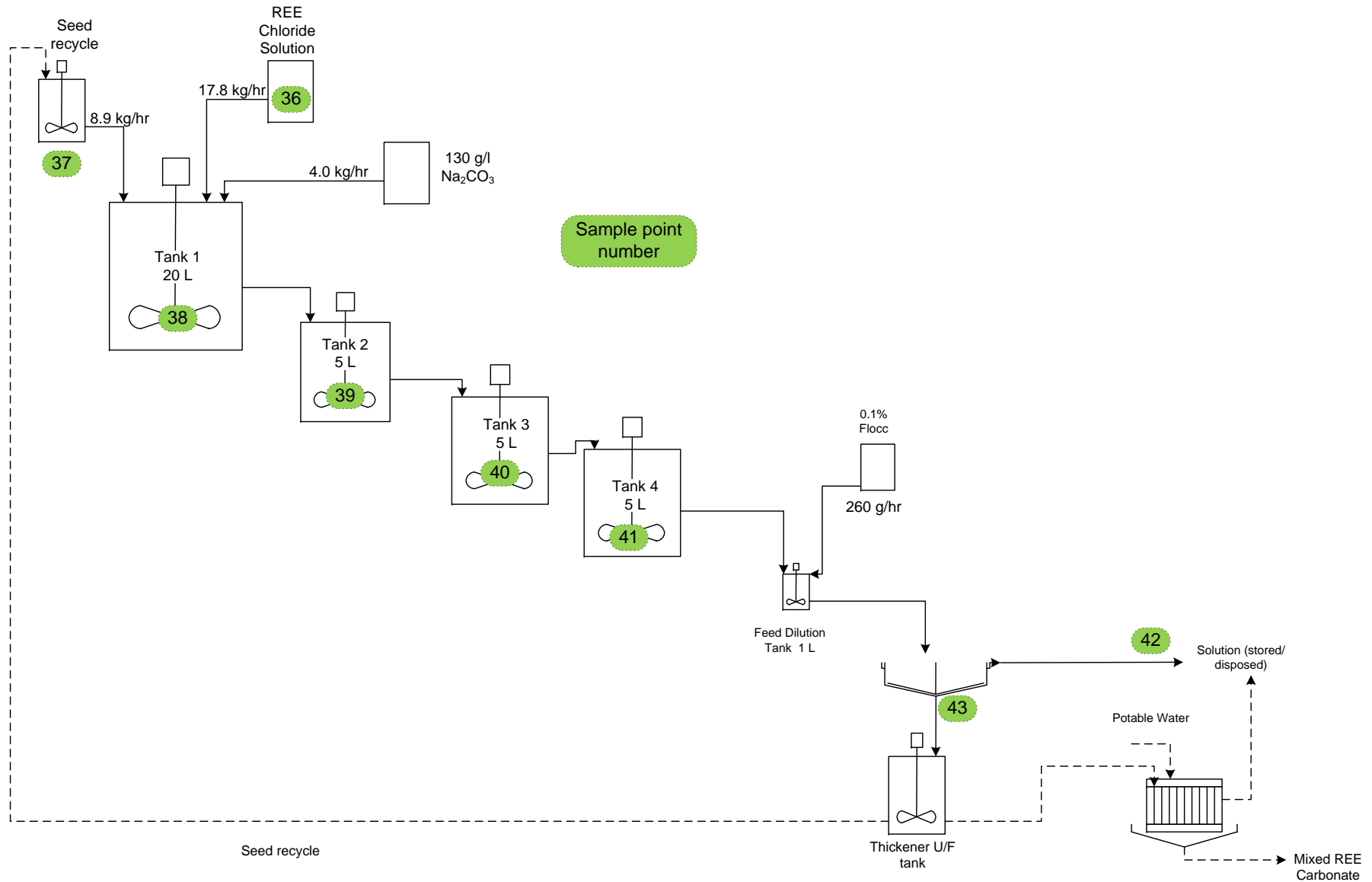
Phase 4

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Pilot Plant Flowsheet Phase 4

Carbonate Precipitation



Carbonate Precipitation

REE Precipitated as Carbonates

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Filtered Product

REE Carbonate Filter Cake

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Washed Final Product

Approximately 50% TREO



Overall Performance

Phase 4

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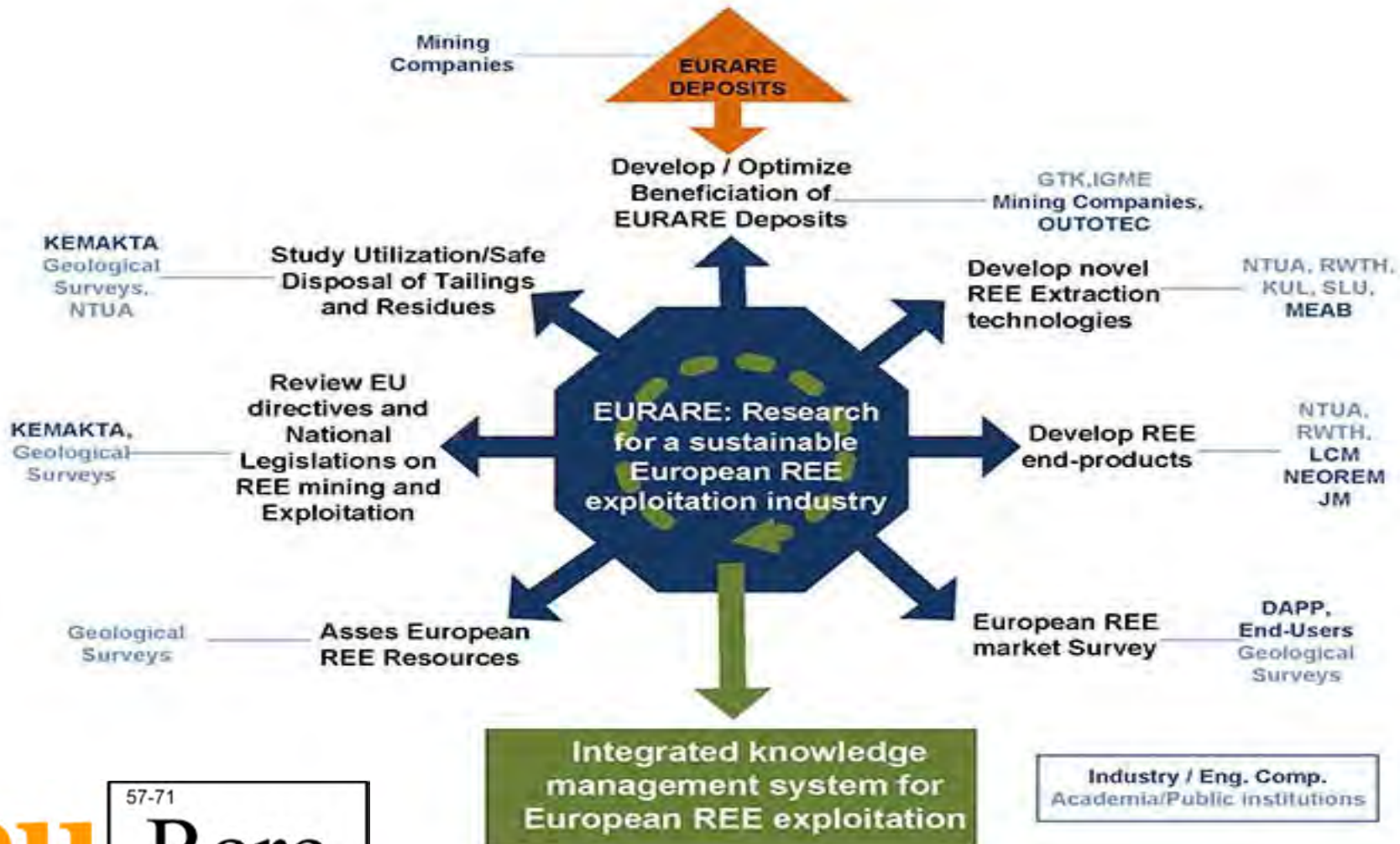


- High availability, no downtime
- High rare earth recovery from solution
- Good selectivity against impurities (Ca)
- No requirement to heat circuit confirmed
- Simple circuit operability based on pH

About the EURARE Program

GMEL is one of the participating Mining Companies

Outotec



Industry / Eng. Comp.
Academia/Public institutions

Introduction: Greenland Minerals and Energy

Key Highlights – A unique world class mining project



GREENLAND
MINERALS AND ENERGY LTD

1

World-class, large scale development project

- Economically robust, proven technology, large-scale, long life production of rare earths and uranium
- Large JORC resource base to produce ~8kt CREO, ~15kt LREO & 1Mlbs U₃O₈ per annum over 37 year mine life
- Ideally located near international airport, existing towns and potential hydro-electric power source

2

Very attractive commodity portfolio

- Heavy rare earths and uranium are both recognised as strategically important commodities for the future
- Rare earths market characterised by limited capacity and increasing demand (particularly Dy, Nd, Tb, Eu and Pr)

3

Strong management and technical team

- Experienced management team with proven track record
- Well-respected and knowledgeable technical/project team in place with exceptional local expertise

4

Highly advantageous ore-type, makes for simple cost-effective processing, highly scalable production

- Low mass -high grade mineral concentrate produced through beneficiation
- Easy atmospheric leaching of the mineral concentrate

5

Globally significant, long life, low cost, multi-commodity asset

- Company to become one of the largest producers of rare earths globally and major U₃O₈
- Company has low cost of production due to multiple by-product opportunities

6

Low political risk

- Stable, low-risk operating environment with government looking to develop new industries and employment
- GME fully permitted to evaluate the project, exploration licence now includes radioactive elements
- Management and board have a solid working relationship with the government and are socially aware