Expansion of Domestic Production of Lithium Carbonate and Lithium Hydroxide to Supply US Battery Industry

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Overview

Expand Lithium Raw Material Base in US

Timeline
Start Date: April 14, 2010
End Date: December, 2013

Barriers
Geothermal Resource Strength and Viability of Geothermal resource

Budget
DOE Share - $28.4 million
Rockwood Share - $46.0 million

Partners
Engineering: BE&K (a KBR company)
Environmental Assessment: Nevada Bureau Land Mgmt
Relevance: Domestic Source of Strategic Materials

- Objectives

  - Expand domestic lithium carbonate and lithium hydroxide production to supply the US electric drive automotive market.
  
  - Deliver high quality lithium products to battery component manufacturers to produce high quality lithium ion batteries.
  
  - Create construction jobs over three years in the US and permanent jobs for production of lithium raw materials.
  
  - Stimulate the US economy with worthwhile long term benefits that will support the conversion to electric drive mobility.
Relevance: Domestic Source of Strategic Materials

• Milestones
  – Deliver battery grade lithium products to the DOE and component manufacturers in 2012 from this project.
  – Maintain the long term viability of domestic production of lithium raw materials by lowering operating cost and at the same time reducing fossil fuel based energy consumption.
  – Job Creation throughout 2010-2013 for engineering and construction peak at over 200 workers and 47 permanent positions.
  – Stimulate the US economy with over $75 Million in direct spending over the three year period.
Relevance: Job Creation

Number of People Directly Employed

Month / Year

LiOH Construction
Geothermal Construction
Production Permanent 47
Engineering
Relevance: Economic Stimulus

Direct Spending (not including peripheral effect)
Approach: Expand Domestic Production of Key Lithium Raw Materials

- Clayton Valley, Silver Peak, Nevada: Lithium Carbonate Production
- Kings Mountain, NC: Lithium Hydroxide Production
Approach: Lithium Carbonate Expansion
Solar Evaporation Ponds in Silver Peak, Nevada
Approach: Lithium Carbonate Expansion

- Expand lithium carbonate plant in Nevada using green technology.
  - Expand use of solar energy used to evaporate water and concentrate lithium in brine.
  - Install a new geothermal power plant to provide electricity for pumping and processing lithium brines and conversion into lithium carbonate.
  - Create the greenest lithium carbonate plant in the world with an energy usage of 99+ % solar and geothermal.
  - Technical barrier is geothermal viability. Exploration will determine whether sufficient resource is available. Early indications are favorable.
  - Go/no-go decision on geothermal in 2012 based on resource temperature and flow.
  - Environmental assessment of geothermal production currently underway in joint effort between Chemetall Foote, DOE and Nevada BLM.
Approach: Geothermal Power Plant

4.0 MW Net Binary Condensing Steam Plant Schematic

- 5,000 kW Gross Output
  - 227 kW Prod. Well Pump
  - 227 kW Inj. Well Pump
  - 150 kW CW Pumps
  - 0 kW Cooling Fans
  - 355 kW Feed Pumps
  - 30 kW Misc. Loads
  - 4,011 kW Net Output

Note: 20% parasitic electrical load
Approach: Geothermal Power Plant

Results of Geotechnical Evaluation

- Fractured zones (fault lines) identified
- Blue = rock
- Red = brine
Silver Peak Equipment
Geothermal Generator Set

Elliott Energy Recovery Turbine

Design Conditions

Dual Pressure Binary Turbine

Mol. Wt. - 57.98

Inlet Pressure - 301/202 psia

Inlet Temperature - 340/180°F

Exhaust Pressure - 50.99 psia

Exhaust Temperature - 117/109°F

Max. Exhaust Pressure - 640 psig

Max. Exhaust Temperature - 320°F

Rated Power Output - 7225 kW

Design Power Output - 6931 kW/6260 RPM

Western Power Transmission

6260 RPM / 1797 RPM

6931 HP (7225 kW)

Ideal Electric Company

Brushless AC Generator

7200 kW

8000kVA

1600 RPM

4160V

Rockwood
Powered by Lithium
Approach: Lithium Hydroxide Plant

• Kings Mountain Lithium Hydroxide Plant will use best available technology developed by Chemetall Foote.

• Combination of purification techniques will provide battery grade lithium hydroxide for the automotive industry.

• Key parameters are low variability, low concentration of contaminants.

• Major milestones are start of construction late 2010 and startup early 2012.
Technical Accomplishments and Progress

- Project Approved April 14, 2010.
- Lithium Hydroxide Basic and Detailed Engineering Complete
- Major equipment installed
- Piping/Electrical Finished end of February
- Commissioning in March 2012
- Startup of Lithium Hydroxide Plant April 2012
- Geotechnical evaluation completed at Silver Peak shows high feasibility for geothermal power plant
- Drill Rig in operation
- Pond remediation underway
- Overall Spending over $35 Million of $75 Million forecast
Lithium Hydroxide Expansion

• Condensers
Lithium Hydroxide Expansion

- Supersack and Drum Filling Line
- Bagging Line
Collaborations/Partnerships

- Engineering complete has been primarily in conjunction with BE&K (a KBR company located in Birmingham, AL).

- Environmental assessment for Geothermal is a joint effort by DOE, Chemetall Foote and the Nevada BLM.
**Completed and Future Work**

- **2010**
  - Completed basic engineering Lithium Hydroxide, purchased major equipment, started preparation for construction
  - Completed exploration for Silver Peak Geothermal viability
- **2011**
  - Completed purchase of equipment and detailed engineering for lithium hydroxide plant
  - Completed majority of construction of lithium hydroxide plant
  - Completed first go/no-go point for geothermal project
- **2012**
  - Start up lithium hydroxide plant April 1st
  - Complete lithium carbonate expansion drilling program
  - Drill observation and first production well for geothermal plant and reach second go/no-go point
  - Order long lead equipment
  - Start construction of geothermal power plant
- **2013**
  - Complete production well drilling and pipe line construction
  - Startup geothermal plant
Summary

- **Objective:** Supply key raw materials to lithium battery industry and create jobs and support stimulus of US economy.

- **Relevance:** Chemetall Foote is only domestic supplier to lithium battery industry and is expanding operations.

- **Approach:** Lower costs and improve technology to enhance ability to be long term supplier to industry.

- **Milestones:** Geothermal plant go/no-go feasibility decision point reached in 2012 but other portions of project are low risk – proven technologies being implemented.

- **Timeline:** All projects implemented between first quarter 2012 and fourth quarter 2013.