



VERTICALLY INTEGRATED MASS PRODUCTION OF AUTOMOTIVE CLASS LITHIUM ION BATTERIES

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Project ID: ARRAVT018**

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Overview

Timeline

- Project start date: 3 Dec 2009
- Project end date: 2 Dec 2012
- Percent complete: 5%

Barriers

- Barriers addressed
 - + Cost
 - + Performance (energy density)
 - + Manufacturability

Budget

- Total project funding: \$498.18M
 - DOE share: \$249,090,000
 - Contractor share: \$249,090,000

Partners

- DOE – USABC
- Equipment and materials suppliers

Objective

- The overall objective of this project is to establish the manufacturing capability in the US to produce at least 500 MWh of automotive lithium ion batteries per year by the end of 2012.
 - + A123 will build a vertically-integrated factory capacity that encompasses the full production process, including: the manufacturing of cathode powder, electrode coating, cell fabrication, module fabrication, and the assembly of complete battery pack systems ready for vehicle integration. Design and production validation will also be performed under this program, ensuring that the products meet customer specifications, and that the production lines conform to standard automotive practice.

Relevance

- Establishing automotive lithium ion battery manufacturing directly addresses the VT Program goal to develop more energy efficient and environmentally friendly highway transportation technologies that enable America to use less petroleum.
- The batteries manufactured under this program will provide Americans with greater freedom of mobility and energy security, with lower costs and lower impacts on the environment.

Approach/Strategy

- The general philosophy of manufacturing expansion is to cost-effectively meet the rapidly escalating customer volume needs while managing operational risk. This approach will begin with low-risk, mature process technologies, improve the processes, and systematically increase throughput and lower costs over time. The first portion of the build-out involves the rapid deployment, using a “Copy Identical” approach wherein the initial USA-1 cell and module/pack factory capacity will be installed with the same processes and equipment currently used in the Recipient’s Asian factories, while increasing the level of automation for material movement and process control to increase output and boost productivity. This work will mostly occur in 2010 (Site 1).

Approach/Strategy, continued

- The second portion of the build-out uses nearly identical equipment as what is used in the Site 1 production, but with increased throughput at specific operations that are at low risk. This “Copy Improve” high volume manufacturing (HVM) capacity will further reduce cost and headcount through additional automation, data collection and improved manufacturing execution platforms. Although this work starts in 2010, the production facilities will not be operational until 2011, with additional capacity being brought online in 2012. Sites 2 and 3 of the manufacturing plan will use this “Copy Improve” philosophy. The Recipient will continue to improve specific operational output in powder, coating and cell assembly, as part of an ongoing effort to continuously improve productivity.
- The build-out of the manufacturing capability will occur in three (3) years, each corresponding to a specific location.

Approach/Strategy, continued

- The build-out of the manufacturing capability will occur in three (3) years, each corresponding to a specific location.
- **Site 1 – Cell Plant and Module/Pack Assembly Plant (Building USA-1)**
- **Site 2 – Powder Plant & Coating Plant (Building R1)**
- **Site 3 – Cell Manufacturing & Module/Pack Assembly (Building B1)**

Site 1 – Cell and Module/Pack Assembly Plant (Building USA-1)

- Site 1 focuses on the Low Volume Manufacturing plant using the “Copy Identical” approach and represents the bulk of the work of the project for 2010. Due to the timing of the Recipient’s needs, some of the Site 1 activity has already started. These activities include USA-1 (Livonia) site selection, due diligence, expansion of engineering “core team”, execution of lease documents and preliminary design /permitting of the facility.

Site 2 – Powder Plant & Coating Plant (Building R1)

- Sites 2 and 3 use the “Copy Improve” approach, which uses nearly identical equipment as what is used for Site 1 production, but with increased throughput at specific operations that are at low risk. This “Copy Improve” high volume manufacturing (HVM) capacity will further reduce cost and headcount through additional automation, data collection and improved manufacturing execution platforms. Site 2 represents the first portion of powder and coating manufacturing on this program.

Site 3 – Cell Manufacturing & Module/Pack Assembly (Building B1)

- Site 3 represents additional cell manufacturing and the first module/pack assembly facility on this program.

Design and process validation

- Cell Design Validation (DV) is used to ensure that the cell meets specification and is accomplished through a Design Verification Plan and Report (DVP&R) process, which includes cell-level performance, life, environmental, and abuse testing.
- Production Validation (PV) testing is used to determine whether the process is capable of producing consistent product, while meeting the demands during an actual production run at quoted production rate.
- The Production Part Approval Process (PPAP) process includes many elements to ensure that specifications and requirements are understood and that the production process has the capability to consistently meet the requirements at production rate. Examples of PPAP elements include: design records, engineering change documentation, Engineering Approval, Design Failure Mode and Effect Analysis (DFMEA), Process Flow Diagram, Process Failure Mode and Effect Analysis (PFMEA), Control Plan, and Measurement System Analysis (MSA) Studies.

Task 1 subtasks

Establish Cell manufacturing in Building USA-1, the Low Volume Manufacturing facility.

Subtask 1.1 Revise and maintain Project Management Plan; Report on activities

Subtask 1.2 Hire engineering and manufacturing core team leaders. Complete factory design, layout, cost estimate, schedule and permits. Complete construction of all non-Manufacturing areas of building and order long lead facilities equipment.

Subtask 1.3 Order, install and qualify equipment for cell design validation (DV) for cells. Start cell DV for cells made in existing plants as baseline for DV from US plants..

Subtask 1.4 Order cell manufacturing line equipment and dry rooms. Begin construction of manufacturing areas and environmental mitigation equipment areas.

Subtask 1.5 Complete construction; Install and qualify dry rooms and cell manufacturing line equipment.

Subtask 1.6 Ramp-up of labor hiring to support manufacturing capacity

Subtask 1.7 Complete Production Validation (PV) and Device Validation (DV) of cell manufacturing lines

Subtask 1.8 Complete Production Part Approval Process (PPAP) for cell manufacturing lines

Milestones Stage Gate Review 1

The Stage Gate Review will be used to assess whether the goal of establishing Pcell manufacturing was achieved. Completion of Production Part Approval Process (PPAP) for the cell manufacturing is the key criterion for successful completion of the Site 1 activity.

Task 2 subtasks

Task 2.0 – Establish one powder and one coating manufacturing block in Building R1.

- Subtask 2.1 Revise and maintain Project Management Plan; Report on activities
- Subtask 2.2a Hire engineering and manufacturing core team leaders. Design powder manufacturing line, layouts, cost estimate , schedule, permits and begin construction
- Subtask 2.2b Hire engineering and manufacturing core team leaders . Design coating line, layouts, construction drawings, cost estimates, schedule, permits and order long lead facility systems. Begin construction of all non-manufacturing areas.
- Subtask 2.3a Order powder manufacturing equipment and environmental mitigation systems. Begin construction of manufacturing areas.
- Subtask 2.3b Order coating manufacturing equipment and environmental mitigation systems. Begin construction of manufacturing areas.
- Subtask 2.4a Complete construction; Install and qualify powder manufacturing equipment
- Subtask 2.4b Complete construction; Install and qualify coating manufacturing equipment
- Subtask 2.5 Ramp-up of labor hiring to support manufacturing capacity
- Subtask 2.6a Complete production validation (PV) of powder line
- Subtask 2.6b Complete production validation (PV) of coating line
- Subtask 2.7 Complete Production Part Approval Process (PPAP) for powder and coating lines

Task 3 subtasks

Task 3.0 – Establish cell/module/pack manufacturing blocks in Building B1.

- Subtask 3.1 Revise and maintain Project Management Plan; Report on activities
- Subtask 3.2a Hire engineering and manufacturing core team leaders. Design cell manufacturing line, layouts and construction drawings. Complete cost estimate, schedule, permits and begin construction. Order long lead facilities equipment.
- Subtask 3.2b Hire engineering and manufacturing core team leaders. Design module/pack manufacturing line, layouts and construction drawings. Complete cost estimate, schedule, permits and begin construction. Order long lead facilities equipment and begin construction of non-manufacturing areas.
- Subtask 3.3a Order cell manufacturing equipment and begin construction of manufacturing areas.
- Subtask 3.3b Order module/pack manufacturing equipment and begin construction of manufacturing areas.
- Subtask 3.4a Complete construction; Install and qualify cell manufacturing equipment.
- Subtask 3.4b Complete construction; Install and qualify module/pack manufacturing equipment.
- Subtask 3.5 Ramp-up of labor hiring to support manufacturing capacity
- Subtask 3.6a Complete production validation (PV) of cell manufacturing line
- Subtask 3.6b Complete production validation (PV) of module/pack manufacturing line
- Subtask 3.7 Complete Production Part Approval Process (PPAP) for cell and module/pack lines

Milestones

- Milestones Stage Gate Review 1
The Stage Gate Review will be used to assess whether the goal of establishing Pcell manufacturing was achieved. Completion of Production Part Approval Process (PPAP) for the cell manufacturing is the key criterion for successful completion of the Site 1 activity.
- Milestones Stage Gate Review 2
The Stage Gate Review will be used to assess whether the goal of establishing powder and coating manufacturing was achieved. Completion of Production Part Approval Process (PPAP) for the powder and coating lines is the key criterion for successful completion of Site 2.
- Milestones Stage Gate Review 3
The Stage Gate Review will be used to assess whether the goal of establishing cell and module/pack manufacturing was achieved. Completion of Production Part Approval Process (PPAP) for the cell and module/pack manufacturing is the key criterion for successful completion of Site 3.

Technical Accomplishments and Progress

December 3, 2009 – December 31, 2009

- **Overall Program Status:**

- + Completed the Agreement Terms and Conditions
- + Completed Budget Justification application and provided back up evidence for cost estimates
- + Received approval for Grant
- + Submitted draft Environmental Assessment to NEPA
- + Registered for ARRA on FedConnect

Technical Accomplishments and Progress

December 3, 2009 – December 31, 2009, Cont.

- **Project 1 – Livonia – Cell Assembly**
 - + Completed demolition of manufacturing areas and office space
 - + Completed changes to exterior of building (ADA access, HEV charging stations, parking lots, landscaping, lighting, underground utilities)
 - + Completed construction package for offices and ASG areas
 - + Received construction permit
 - + Received Air Emissions waiver from Michigan Department of Environmental Quality
 - + Completed design and Ordered Dry rooms for cell assembly
 - + Ordered 10 cpm prismatic cell assembly equipment
 - + Ordered 10 cpm prismatic formation and aging equipment
 - + Ordered automated module and pack assembly and test equipment
 - + Ordered Cell DV&R equipment
 - + Designed Cell DV&R room; Sent out for bids; awarded construction contract

Technical Accomplishments and Progress

December 3, 2009 – December 31, 2009, Cont.

- **Project 2 – Romulus – Powder & Coating**
 - + Completed Level 1 Environmental Site Assessment
 - + Submitted Permit to install application to Michigan Department of Environmental Quality (MDEQ)
 - Completed lease approval for Romulus campus
 - Started preliminary design for Coating operations

Technical Accomplishments and Progress

December 3, 2009 – December 31, 2009, Cont.

- **Environmental Assessment (NEPA)**

- + Draft completed and in NEPA internal review
- + NEPA Counsel review to be done in February 2010
- + Public comment period completed in March 2010

- **Michigan Department of Environmental Quality (MDEQ)**

- + **Livonia:**

- MDEQ waiver approved for air emissions – No PTI needed

- + **Romulus:**

- PTI submitted to MDEQ in December 2009 – In review
- Expecting approval in March 2010
- Construction Waiver granted for limited construction
- Will be hiring local environmental consultants to participate in factory design team

Technical Accomplishments and Progress

January 1– April 26, 2010

- **Overall Program Status:**

- + Completed Kick Off meeting with NETL and DOE
- + Attended EVMS webinar
- + Completed FONSI for Environmental Assessment
- + Received revised documents to remove 10% limitation for reimbursement based on FONSI completion

Technical Accomplishments and Progress

January 1– April 26, 2010, continued

- **Project 1 – Livonia – Cell Assembly**

- + Completed move from Novi to Livonia (ASG group)
- + ASG Labs construction and equipment installation completed and operational
- + Dry Room construction started (over 50% completed)
- + First Cell Assembly equipment delivered for 10 cpm
- + Automated Formation and Aging systems delivered
- + Additional 10 cpm equipment ordered

Technical Accomplishments and Progress

January 1– April 26, 2010, continued

- **Project 2 – Romulus – Powder & Coating**

- + Design firm selected and Schematic design started
- + Interviewing Construction firms
- + Starting office renovations
- + 20 cpm equipment ordered

- **Project 3 – Brownstown – Cell Assembly**

- + Received all Level 1 Site Assessments
- + Started final lease negotiations

Technical Accomplishments and Progress

January 1– April 26, 2010, continued

- **Environmental Assessment (NEPA)**
 - + Received FONSI for Environmental Assessment on April 23

- **Michigan Department of Natural Resources and Environment (MDNRE), formerly MDEQ**
 - + **Livonia:**
 - MDEQ waiver approved for air emissions – No PTI needed
 - + **Romulus:**
 - In final stage of PTI application approval

Collaboration and Coordination with Other Institutions

- A123 has been working closely with equipment suppliers to ensure timely delivery
- The products to be made on this program have been developed, in part, through DOE-funded USABC programs
- A123 has been working closely with the Michigan Department of Natural Resources and Environment (MDNRE), formerly MDEQ

Summary

- A123 continues to make excellent progress on this program
 - + Completed move from Novi to Livonia (Automotive Solutions Group)
 - + ASG Labs construction and equipment installation completed and operational
 - + Cell assembly equipment delivered
- Completed Finding of No Significant Impact (FONSI) for Environmental Assessment

Future Work

- Livonia
 - + Complete dry room construction
 - + Begin cell assembly (Q3 2010)
- Romulus
 - + Complete facility design
 - + Begin construction of facility
 - + Complete office renovation
 - + Begin powder and coating fabrication
- Brownstown
 - + Finalize lease