


Advanced Li-Ion Polymer Battery Cell Manufacturing Plant in USA

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LG Chem Michigan Inc.

May 16, 2012

Project ID : ARRAVT001

This presentation does not contain any proprietary, confidential, or otherwise restricted information

OVERVIEW

TIMELINE

- Start date : 09/01/2009
- End date: 05/31/2013
- Percent Complete: 85%

BARRIERS

- Investment Cost Increase
- Adaptation and application of new technology into a new facility

BUDGET

- Total Project Funding:
  -DOE Share: $151,387,000
  -LGCMI Share: $155,140,000
- Funding Received by 2012.1Q : 123.8M
- Funding for FY2012 Project : 27.5M

PARTNERS

- DOE/NETL
- LG Chem Ltd.
- Architect & Engineering Firm
- Design Builder
- State of Michigan
- City of Holland, MI
- Various suppliers in near Holland

PROJECT OBJECTIVE
: LI-ION BATTERY CELL MANUFACTURING FACILITY

To design, construct, start-up and validate a production facility for Li-Ion Polymer Batteries in Holland, Michigan, USA.

- After starting assembly operations in 2012, the various efforts will be continued through 2013 to stabilize production and to provide quality products to customers. A high volume electrode manufacturing line will also be installed.
- When it reaches full-scale operation in 2013, more than 250 direct employees (Operators, Engineers, Management & Administration staff) will be working at the facility.

Number of Employee by Year

MILESTONES I.

On schedule and no issues.

Schedule

Classification		2010	2011	2012	2013
Phase I (Assembly)	Building	6	Completion of Building 9	Mar	
	Equip -ment	11		Q2	
Phase II (Electrode)	Building		6	6	
	Equip- ment		6		Q2

Updates

Phase I : Complete

- Completed all construction work in 2011
- Completed production equipment installation
- Under process / product verification

Phase II (Electrode Line) : On-track

- Construction progress: 100%
- Under equipment installation

MILESTONE II.

2010

08/2009 DOE Grant Award

05/2010 Completion of General Contractor Selection

07/2010 Groundbreaking Ceremony

2011

02/2011 Completion of Enclosure

06/2011 Completion of Equipment Delivery

09/2011 Completion of Equipment Set-up

10/2011 Start to Production Process Verification

2012

01/2012 Achieved the ISO/TS 16949 LOC

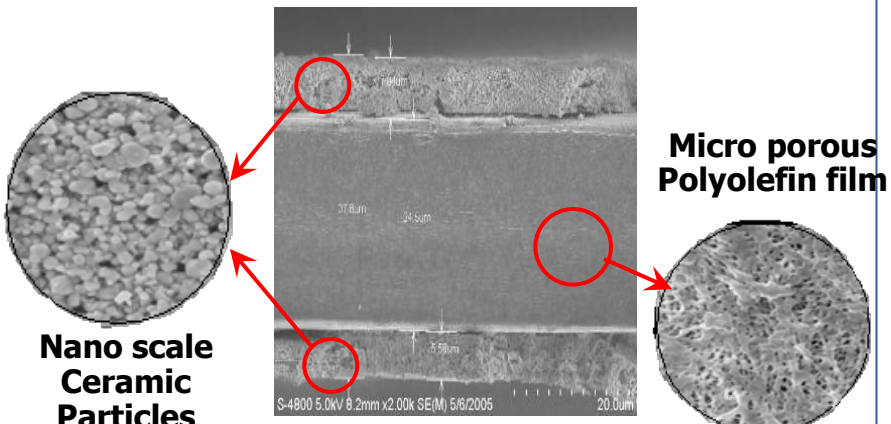
03/2012 Under Product and Process Verification

INTRODUCTION OF UNIQUE TECHNOLOGY

LGCMI introduced the following two unique technologies from Korea to USA.

SRS™

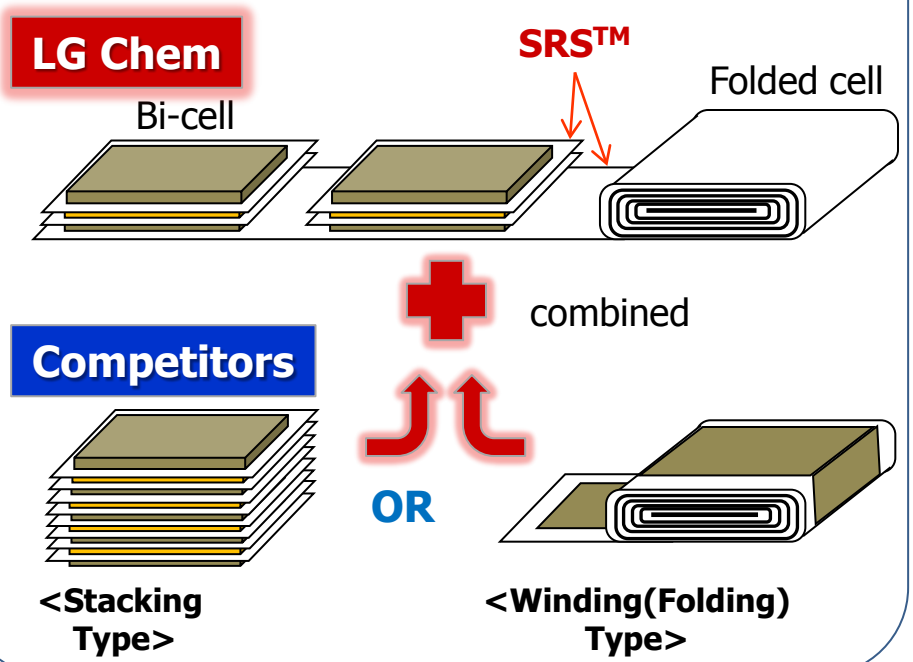
- Breakthrough technology to prevent safety issues in the Li-ion battery
- Mechanically, thermally improved separator



Cross Section of SRS™

STACK & FOLDING

- Stack the cut electrodes (bi-cell), then fold the bi-cells with SRS™ to make cells
- Safety, Performance excellence



MANUFACTURING FACILITY

With the cooperation of various USA partners, the building and its utilities were efficiently constructed and installed to support cell manufacturing technologies.

Regenerative Thermal Oxidizer

Bird Eye View of LGCMI

Dry and Clean Room

Road Expansion by City of Holland

Acetone Tank and Nitrogen Tank

VERIFIED EQUIPMENT

The verified quality equipment that has been used in Ochang, Korea was duplicated and set-up in Holland, USA.

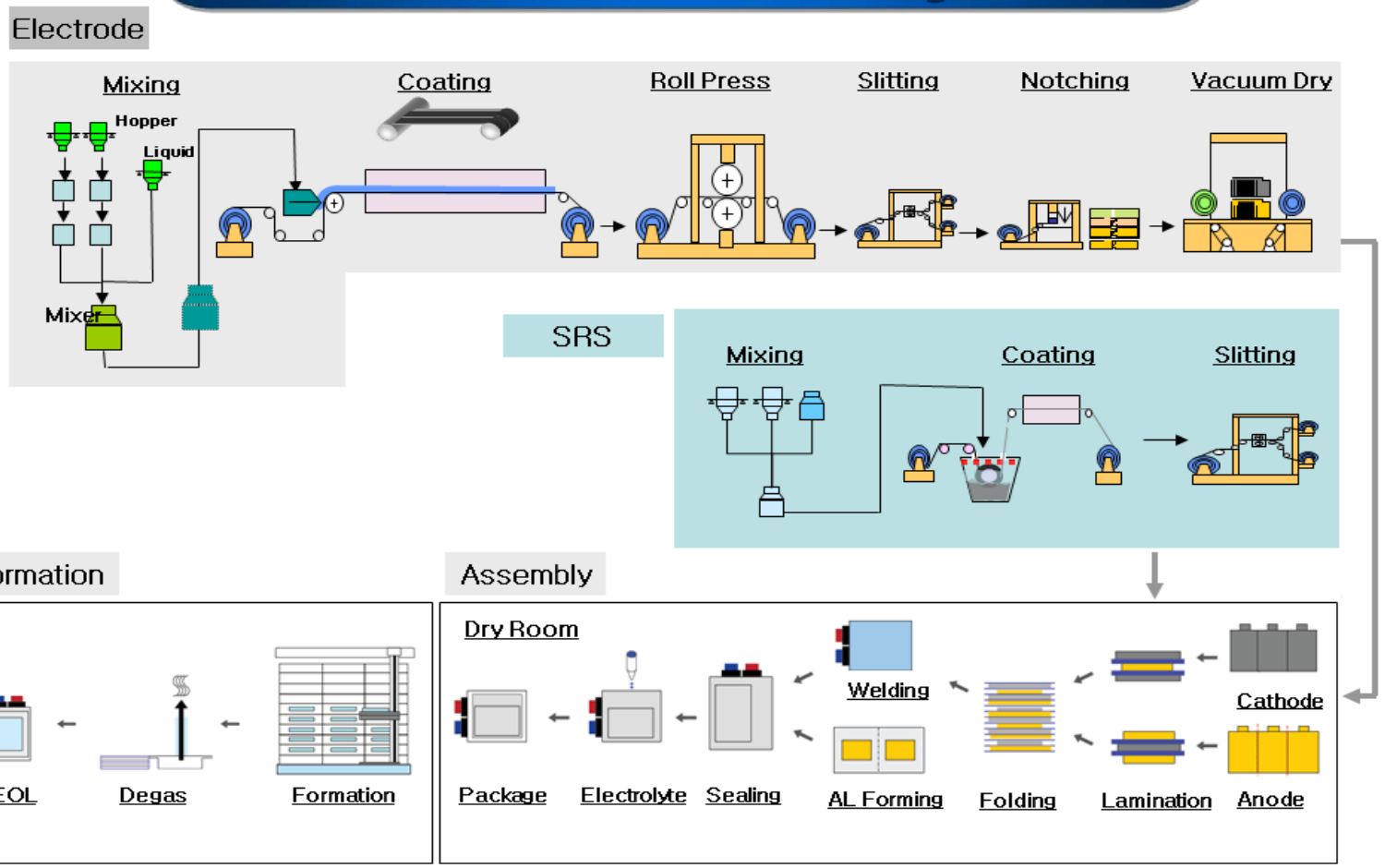
LG Chem (Ochang, Korea) = **LGCMI (Holland, MI, USA)**

SRS	Mixing Equipment Coating Equipment
Assembly	Notching Equipment Lamination Equipment Folding Equipment Packaging Equipment
Formation	Charging/Discharging Equipment Aging Equipment
QA	Inspection Equipment Test Equipment
Electrode	Mixing Equipment Coating Equipment

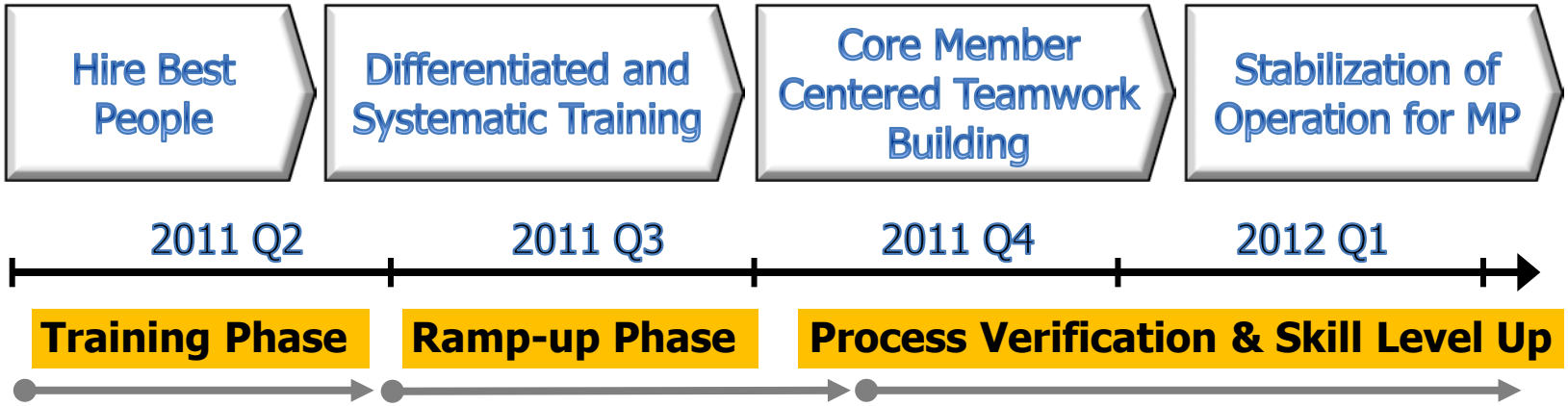
REPLICATION OF PRODUCTION PROCESS

Adopted and replicated the most cutting edge Li-ion cell manufacturing process into USA.

LG Chem's Cell Manufacturing Process



SUCCESSFUL HIRING AND TRAINING



	Training Phase	Ramp-up Phase	Process Verification & Skill Level Up
Engineers	•Training in Korea (for 10~12 weeks) •Training on supplier site	•Equipment set-up •Prepare for operation -Training -Daily Report	•Production Validation & operator training •Preparation for production and indirect preparation •Implement plan by sections
Senior Operator	Senior Operators •Training in Korea		
Operator	•3 times of Job Fairs (April ~ June)	•GRCC Training •Basic On-the-Job Training	•Concentrated and in-depth hands-on Training

STANDARDIZED ISO/TS 16949 SYSTEM

Set-up the overall plant system in accordance with ISO/TS 16949:2009. LGCMI Received ISO/TS 16949 LOC(Letter of Conformance) on January 31, 2012.

DET NORSKE VERITAS

DNV

LG Chem Michigan Inc.
1 LG Way, Holland,
MI, USA 49423

Att: Hee Yil, Ro

Your ref:

Our ref:
PRJC-25781-2007-MSC-KOR

Date:
February 07, 2012

LETTER OF CONFORMANCE

Dear Hee Yil, Ro,

We are pleased to advise you, based on our audit at LG Chem Michigan Inc., you have received Technical approval on January 31, 2012 and that you have satisfactorily addressed the management system requirements identified in ISO/TS 16949:2009 with the exception of having the required 12 months performance data for that site.

Per the ISO/TS 16949:2009 "Rules for achieving IATF recognition", you must have 12 months performance data to be issued an ISO/TS 16949:2009 certificate. Therefore, for LG Chem Michigan Inc., we are issuing you this letter of conformance which expires on January 31, 2013. Once you have the required 12 months of performance data, we will re-evaluate. A Special Audit will be performed and if the results are deemed satisfactory, an ISO/TS 16949:2009 certificate will be issued at that time.

Best Regards
for for

Peter Herman

Peter Herman
Technical Specialist

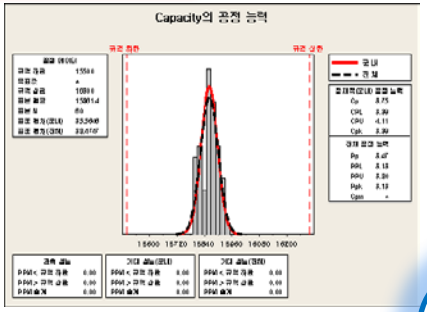
INTENSIVE PROCESS VERIFICATION

Intensive process and product verification tests are on-going.
(Process capability, dimensions, performance, reliability and safety, etc)

➡ Identically similar results between Korea and USA produced cells

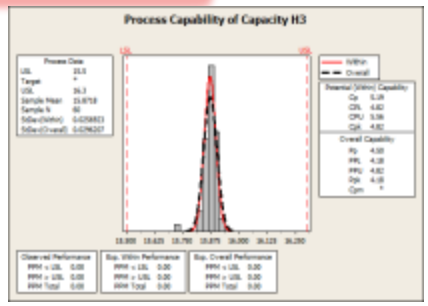
Ochang Line 3

Capacity	
Average	15.86
Maximum	15.94
Minimum	15.79
N	60
CpK	3.39



Holland Line 3

Capacity	
Average	15.87
Maximum	15.92
Minimum	15.73
N	60
CpK	4.82



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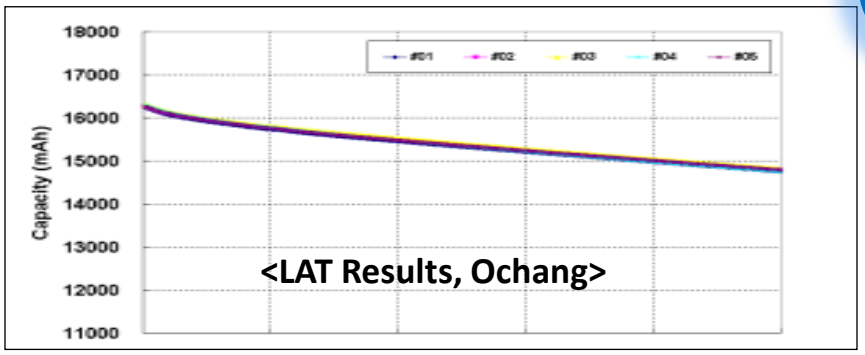

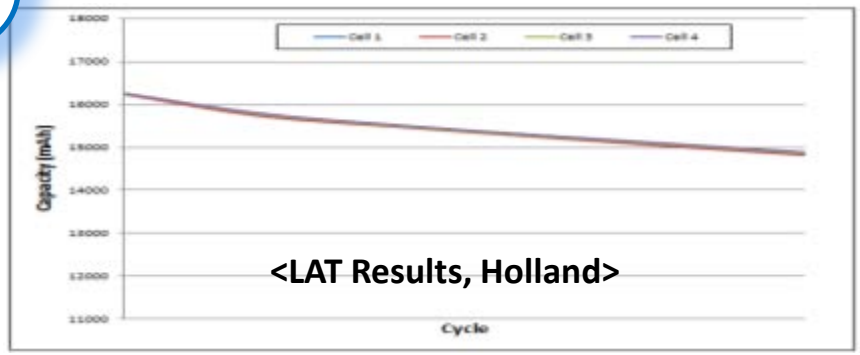

COLLABORATIONS & PARTNERSHIPS

Due to the great collaboration and enormous support from various public and private sectors, LGCMI could achieve the current status.

- **DOE/NETL**
  - ❑ Clear guidelines for the DOE billing and reporting requirements
  - ❑ Quick responses to specific inquiries
- **State of Michigan**
  - ❑ Financial incentives (=tax credit) to LG Chem Michigan Inc.
  - ❑ Coordination with state agencies (e.g., environmental permits)
- **City of Holland**
  - ❑ Support and assistance in various areas (e.g., road expansion, site preparation)
  - ❑ Renaissance zone designation in coordination with the State of Michigan
- **Private Sector Partnership**
  - ❑ Timely cooperation and excellent support in the various stages of the project
  - ❑ Anchor company of Michigan's SmartCoast Advanced Energy Storage cluster

SUMMARY

LG Chem/LGCMI successfully completed project phase I.

- **Construction of building and facility were completed.**
  - No safety issues and no big troubles.
- **Completed the installation of cell manufacturing equipment.**
  - Verified equipment used in Ochang, Korea was installed and set-up.
- **Successfully replicated the cutting edge manufacturing technologies.**
  - Same advanced technologies for Li-ion cell manufacturing process were introduced to USA.
- **Process and product verification are under testing.**
  - Verification test results have been the same between Ochang, Korea and Holland, USA.
- **ISO/TS 16949 system was implemented .**
  - Received ISO/TS Letter of Conformance on Jan. 31, 2012

SUMMARY (CONT.)

- **Hired and trained full time employees (195 as of 2011)**
  - Trained them with differentiated and systematic training program.
  ➔ Intensive and repeated practice are being performed to achieve a similar skill level with Korea.

Project phase II step(Electrode) is on-track

- **Construction of facility for electrode**
  -Complete

- **Delivery and installation of electrode manufacturing equipment**
  - On-going

FUTURE WORKS

To successfully complete the project, LGCMI's future work shall include:

- **Completion of Electrode Process Set-up**
  - **Successful adoption of most high-end technology for electrode production process**
  - **Need to install and verify electrode equipment**
  - **Continue to hire and train new employees for the electrode process**
- **Customer Approval for Assembly Line**
  - **Will receive official customer approval for the newly set-up assembly production line for mass production.**
  - **PPAP and QSB : On-going**
- **Start of mass production and stabilization of production**
  - **Raise employee skill levels**
  - **Continue to produce best quality products for our customers**

OF THE U.S. PEOPLE, BY THE U.S. PEOPLE, FOR THE U.S. CUSTOMERS

We, as LGCMI, produce the Li-ion cells that will power the electric vehicles of the United States of America.

<LGCMI Employees, Feb 2012>