Electric Drive Semiconductor Manufacturing (EDSM) Center

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Powerex, Inc.
May 10, 2011

Project ARRAVT030
**Timeline**
- Project start date: 12 March 2010
- Project end date: 11 March 2012
- Percent complete: 60%

**Budget**
- Total project funding
  - DOE share: $6,049,581.00
  - Powerex share: $2,592,678.00

**Barriers**
- Equipment integration
- Material handling
- Agility to meet variety of products and industry standards
- Transition from prototype to production

**Partners**
- No partners in grant award
- Leveraging existing customer and supplier relationships
Project Overview

• Powerex corporate offices in Youngwood, PA (near Pittsburgh)
• 250+ employees
• 120,000 square feet of facilities
• Design and manufacture
  – Rectifiers and Thyristors
  – Custom Modules
  – Integrated Power Products
• Markets Include: Automotive/vehicle, transportation, wind, power generation & distribution, motor control, energy conservation
Objective:

Powerex will modify its existing facility to house an integrated Electric Drive Semiconductor Manufacturing (EDSM) Center capable of producing over 100,000 electric drive semiconductor devices annually.

- **EDSM Facility** - Provide a facility capable of meeting all EDSM project objectives
- **Manufacturing Center** - Provide capability to produce, at a minimum, 100,000 electric drive semiconductor devices annually
- **Reliability Center** - Provide the capability to fully test and qualify semiconductor device performance and reliability
- **Prototype Center** - Provide the capability to develop new semiconductor device concepts through prototyping. This capability will reduce risk associated with new semiconductor device performance and reduce risk associated with high-volume manufacturing of new devices.
Phased into Existing Facility

- Maintain continuity of current operations and reduce risk

Phases of Implementation

- **Phase 1**
  - Construct 3,000 sq ft class 10,000 clean room
  - Install & integrate highest risk manufacturing center equipment and processes
- **Phase 2**
  - Add 7,000 more sq ft to class 10,000 clean room; total 10,000 sq ft
  - Install the remaining manufacturing center equipment into the clean room
- **Phase 3**
  - Relocate existing prototype equipment into clean room
- **Phase 4**
  - Install reliability center equipment in space vacated by prototype equipment move
- **Phase 5**
  - Demonstrate capability through Low Rate Initial Production

Combined to better accommodate ongoing plant operations
Approach – Production Process

Cell 1
- Load Fixtures
- Vacuum Solder
- Clean
- TSE Coat
- Case Attach

Cell 2
- TSE Cure
- Clean & Wire Bond

Cell 3 & 4
- Electrical Test

Cell 5
- PCB Attach
- Gel

Cell 6
- Gel Cure
- Lid Attach
- Terminal Forming

Cell 7
- Hi – Pot Test
- Electrical Test
## Project Milestones

<table>
<thead>
<tr>
<th>Milestone</th>
<th>Milestone Date</th>
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<tbody>
<tr>
<td>Clean Room Contract Awarded</td>
<td>June 1, 2010</td>
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<tr>
<td>Phase 1 Manufacturing Center Installation Complete</td>
<td>February 1, 2011</td>
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<tr>
<td>Phase 2 Manufacturing Center Installation Complete</td>
<td>June 1, 2011</td>
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<tr>
<td>Prototype Center Operational</td>
<td>June 1, 2011</td>
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<tr>
<td>Reliability Center Operational</td>
<td>August 1, 2011</td>
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<tr>
<td>Delivery of 10 LRIP Units</td>
<td>October 1, 2011</td>
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<tr>
<td>Initial Operational Capability/Project Complete</td>
<td>November 1, 2011</td>
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- **Sept 15, 2010**
Technical Accomplishments

- Identified highest risk equipment and processes
- Successfully prototyped automated vacuum furnace
- Demonstrated utility of electron and acoustic microscopes in failure and reliability analysis
- Demonstrated key manufacturing processes (use of solder mask and dispensed solder paste, dispensed gels, advanced wire bonding programs)
Deployment Accomplishments

- Clean room installation nearly complete
- Almost all equipment purchased; most delivered
- Already using many new pieces of equipment in revenue production and analysis
Collaboration & Coordination

• No partners are directly involved in execution of grant

• Strong, collaborative partnerships with many critical material suppliers and service providers

• Long-standing relationships with many customers in electric drive industry

• Long-standing teaming arrangements with universities, federal agencies and companies engaged in state-of-the-art power module research
Future Work

In 2011

• Complete clean room installation
• Install, test and integrate manufacturing equipment
• Relocate existing prototype equipment to clean room
• Install and test reliability center equipment
• Conduct Low Rate Initial Production (LRIP) to demonstrate capability
Project Summary

- Grant awarded in March 2010
- Objective: create capacity to design through prototyping, produce and test 100,000 semiconductor power modules annually
- 2-year phased approach to permit risk reduction and implementation in existing plant without impacting on-going production operations
- Project is meeting all technical goals on schedule and within budget
- Clean room nearly complete, most equipment purchased, key processes demonstrated, risks reduced