

**ADMINISTRATIVE INFORMATION**

1. **Project Name:** High-Intensity Plasma Glass Melter—Go13093
2. **Lead Organization:** Plasmelt Glass Technologies, LLC  
2845 29th Street  
Boulder, CO 80301
3. **Principal Investigator:** Michael Weinstein  
(303) 530\_2727 phone  
(303) 200\_7813 fax  
Mike@plasmelt.com
4. **Project Partners:** J. Ronald Gonterman – Plasmelt - Program Director  
AGY – Cost share partner—Steve Allen  
JM – Cost share partner – Mark Langston  
Subcontractors:
  - James Hayward - Independent Consultant - Melting
  - Gabriel Tincher - N.Sight Partners - Marketing Studies
  - David Bennert - InnovaTech - Environmental Testing
  - Oleg Prokhorenko – Lab of Glass Properties - Modeling
5. **Date Project Initiated:** 7/28/04
6. **Expected Completion Date:** 7/27/05

**PROJECT RATIONALE AND STRATEGY**

7. **Project Objective:** Develop a 500 lb/hr transferred-arc plasma melting process that can produce high quality glass suitable for processing into a commercial article.
8. **Technical Barrier(s) Being Addressed:** The preliminary work on glass melting via plasma that was previously conducted by JM showed that good energy efficiency is possible, up to throughputs of 1000 #/hr. However, glass quality was not addressed. Torch life and process stability were the primary technical barriers that were identified from this earlier work. This project is aimed at developing improved torch designs and a stable set of operating conditions as well as the quantitative understanding of the relationship between the operational parameters of the plasma melting system and the effect on glass quality, energy efficiency, and environmental impact.
9. **Project Pathway:** Our current approach is to construct a melting facility that is capable of performing experimental research on melting energy efficiency and environmental impact as well as the glass quality issue that was not previously addressed by the JM work. Poor glass quality is one very key issue that will prevent the adoption of plasma melting technology within the glass industry. Therefore, Plasmelt has constructed the equipment and plans to acquire glass forming technology to establish this link between the process conditions and glass quality. Marbles or patties will be produced under a wide range of experimental operating conditions and experimental torch designs. These assessments will link these process variables and the resultant glass quality, energy efficiency, and environmental impact. The final glass quality assessment will be made through a fiberizing evaluation by one of our cost share partners in their production facility. To the best of our knowledge, this experiment has never been run before. The fiberizing trials will provide key glass quality assessments that should be useful in

convincing other segments of the glass industry that plasma melting has good potential in high quality applications.

#### 10. Critical Technical Metrics:

Technical metrics—Baseline vs. Project Objectives

- Length of runtime of a stable glass melting operation before torches must be replaced (i.e. torch life in hours). Several minutes to a few hours were demonstrated by JM. The objective of this project is to demonstrate 100 hours of routine torch life without interruption.
- Current energy consumption within the glass industry varies widely with segment and type of technology, but generally ranges from 5 to 12 MM BTU/ton of glass melted. The objective of this project is to demonstrate 4.1 MM BTU/ton of glass or less.
- Existing fiber forming technology with good glass quality routinely reaches 0.5 breaks per bushing per hour. Our goal is to achieve at least one break per bushing per hour or better.

### PROJECT PLANS AND PROGRESS

#### 11. Past Accomplishments:

In the first 9 months of the program, we have essentially completed the construction phase and have begun the process development research. Accomplishments to date include the following:

- Designed, fabricated and installed plasma melting system and accessory systems. Systems installed and operational to date include:
  1. More Than 40 Plasma Torch Designs Evaluated
  2. 1.4 Megawatt DC Power Supply and Control Sub-system
  3. 40 ton Water Chilling and Cooling System
  4. Purge Gas Systems
  5. Melter Shell and Accessory Systems
  6. Vent Hood, Ductwork, and Blower System
  7. Electrode Positioning Systems
  8. Mezzanine Structure
  9. Glass Batch Handling Equipment
  10. Cullet Handling System
  11. Facility infrastructure and services upgraded to accommodate 1 through 10 above.
- Will complete first year on or under budget meeting all milestones and project requirements
- Successfully made initial glass melts at rates from 200 to 500 #/hr
- Ran trials of several iterations of preliminary torch designs to select most robust candidate for extended stability glass melting trial runs
- Completed the project milestone planning and resource assignments, operating agreements, subcontractor agreements, IP and license agreements
- Completed the survey for suitable laboratory buildings, selected best candidate, and signed building lease agreements. Retro-fitted the building to operate as a laboratory
- Obtained Exemption from Colorado Dept. of Health & Environmental Control to allow the work to be conducted in Boulder, Colorado
- Designed, engineered, and constructed melter. Started up and debugged operation.
- Initiated market study to determine the size of the market for this technology
- Designed glass delivery channel that will move glass from the melter to the process area
- Relative to marble forming, identified and inspected two lower cost alternative technologies for glass cullet forming, i.e. patty-making and lense-making

- Conducted two Cost Share Partner Review Meetings to solicit input from the partners and to report progress against milestones

#### 12. Future Plans:

- |   |                  |
|---|------------------|
| • Complete the market survey  | May 31, 2004     |
| • Startup and operate at 500 #/hr, conduct preliminary energy balance [GO / NO GO DECISION] Issue preliminary report. | July 27 2004     |
| • Assess Glass Quality: Marble forming installation, marble production and fiberizing testing [GO / NO GO DECISION]   | January 31, 2005 |
| • Optimize energy efficiency, torch design and operation  | June 30, 2005    |
| • Final Report  | July 27, 2005    |

#### 13. Project Changes:

A Design team was assembled and charged with engineering a forehearth system that would produce acceptable marbles for the fiberizing testing to characterize quality. The high cost of the resultant design forced the abandonment of our plans to make marbles. Alternative cullet forms such as patties and lenses are being investigated. It will be necessary to substitute one of these lower cost higher risk cullet forms unless significant additional funding is obtained. Our recommendation is to proceed with one of these lower cost alternatives and we are in the process of soliciting DOE and cost share partner support for this alternative approach.

#### 14. Commercialization Potential, Plans, and Activities:

In order to better understand the niches within the glass industry where the attributes of plasma melting technology would have the greatest benefits, a market study is currently being performed by one of our subcontractors. The results of this study will be used to form the foundation for a Plasmelt business plan, aimed at propagating this plasma melting technology within the glass industry. Preliminary findings suggest that this technology will find the best acceptance within the specialty glass segment of the glass industry. During the next several months, we plan to:

- aggressively seek out individual companies to promote actual melting evaluations in the Plasmelt Boulder Lab using glasses that are of interest to specific companies
- investigate pilot facility installations at one or more cost share partners to quickly follow onto the termination of this 2 year program
- present technical papers at selected meetings of interest to glass companies

#### 15. Patents, Publications, Presentations:

- Advances in the Melting of Glass Conference – Rochester, NY, July, 2003, High Intensity Plasma Glass Melting Project plans and background was presented.
- NREEL Project Review, Golden, CO, September, 2003, Presentation of Program Status of High Intensity Plasma Glass Melter.