

## PROJECT DATA

**University of Missouri - Rolla - 02GO12050**

### Monitoring of Refractory Wall Recession Using Radar Techniques

Recipient:	University of Missouri-Rolla	Instrument Number:	DE-FG36-02GO12050
Recipient Project Director:	Dr. Robert E. Moore 573.341.6326 1870 Miner Circle 215 ME Annex Rolla, MO 65409-0330	CPS Number:	1824
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Recipient Type:	Institution of Higher Learning	GO Contract Specialist:	Melissa Wise 303.275.4907
Subcontractor(s):		B&R Number(s):	ED1805000
		PES Number(s):	02-2274
EERE Program:	Industrial Technologies	State Congressional District	MO - 8

**PROJECT SCOPE:** The project will develop an effective monitoring system that enables glass melters to be managed for optimum efficiency and longevity. The new system will be designed to maximize use and save substantial materials, process energy, and downtime. Research will focus on the recession of refractory walls in contact with commercial glasses and on the adaptation of a special radar technology, the Frequency-Modulated Continuous-Wave Technique, which utilizes simple microwave hardware. Lifetime extension is hard to estimate but it will be assumed that an extension of 10% in refractory life would suggest a savings of around 1.3 billion btu per year, per unit.

#### **FINANCIAL ASSISTANCE**

Approved DOE Budget	\$40,000	Approved DOE Share	\$40,000
Obligated DOE Funds	\$40,000	Cost Share	\$10,000
Remaining Obligation	\$0		
Unpaid Balance	\$0	<b>TOTAL PROJECT</b>	<b>\$50,000</b>

Project Period: 9/1/02 - 8/31/03

**TECHNICAL PERFORMANCE**  
**DE-FG36-02GO12050**  
**University of Missouri-Rolla**  
**Monitoring of Refractory Wall Recession Using Radar Techniques**

**PROJECT SYNOPSIS**

The project will develop an effective monitoring system that enables glass melters to be managed for optimum efficiency and longevity. The new system will be designed to maximize use and save substantial materials, process energy, and downtime. Research will focus on the recession of refractory walls in contact with commercial glasses and on the adaptation of a special radar technology, the Frequency-Modulated Continuous-Wave Technique, which utilizes simple microwave hardware. The system is contained in a portable package that will allow for numerous measurements to be taken over melt container surfaces. It is expected to yield real time data for making critical decisions about the functioning and the optimal utilization of the melt equipment. Lifetime extension is hard to estimate, but it will be assumed that an extension of 10% in refractory life would suggest a savings of approximately 1.3 billion Btu per year, per unit.

Environmental benefit will relate directly to the amount of material that does not have to be recycled or placed in landfills per year.

**SUMMARY OF TECHNICAL PROGRESS**

A Time Domain Reflectometry (TDR) microwave technique was shown to have a potential utility for measuring the thickness of a number of cast and fused-cast Alumina-Zirconia-Silica (AZS) bricks. TDR achieved good results with a high degree of accuracy at room temperature and was used to find the thickness of a refractory wall with known dielectric properties and measured time of flight (TOF). The thickness of fused-cast AZS bricks could not be measured at high temperatures as further studies are required to determine the dielectric properties of AZS at high temperatures.

The network analyzer that was used during the project is not suitable for an industrial environment. It is expensive, sensitive and not easily portable. However, a similar TDR system can be designed to reduce cost and increase ruggedness and mobility. The TDR technique has been proven capable of providing nondestructive, non-intrusive, real-time, in-situ and online refractory wall thickness information. However, further investigations and improvements are required before these methods can be successfully implemented in the industry.

**SUMMARY OF PLANNED WORK**

The project is complete and the final report was submitted in August of 2003.

**PROJECT ANALYSIS**

The project is complete and has been closed out.

**ACTION REQUIRED BY DOE HEADQUARTERS**

No action is required from DOE Headquarters at this time.

**STATEMENT OF WORK**  
**DE-FG36-02GO12050**  
**University of Missouri-Rolla**  
**Monitoring of Refractory Wall Recession Using Radar Techniques**

**Detailed Task Description**

**Task I. Design & Construct the Radar Equipment**

- Procure and assemble radar circuitry & components.
- Design & fabricate refractory metals.
- Assessment of temperature capabilities of radar.

**Task 2: Test Bed Trials of the Radar Using the University of Missouri–Rolla (UMR) Oxyfuel Simulator Furnace**

- Demonstrate the functionality of the radar equipment.
- Design & implement a series of melts of commercial glasses.

**Task 3. Trials in Commercial Settings**

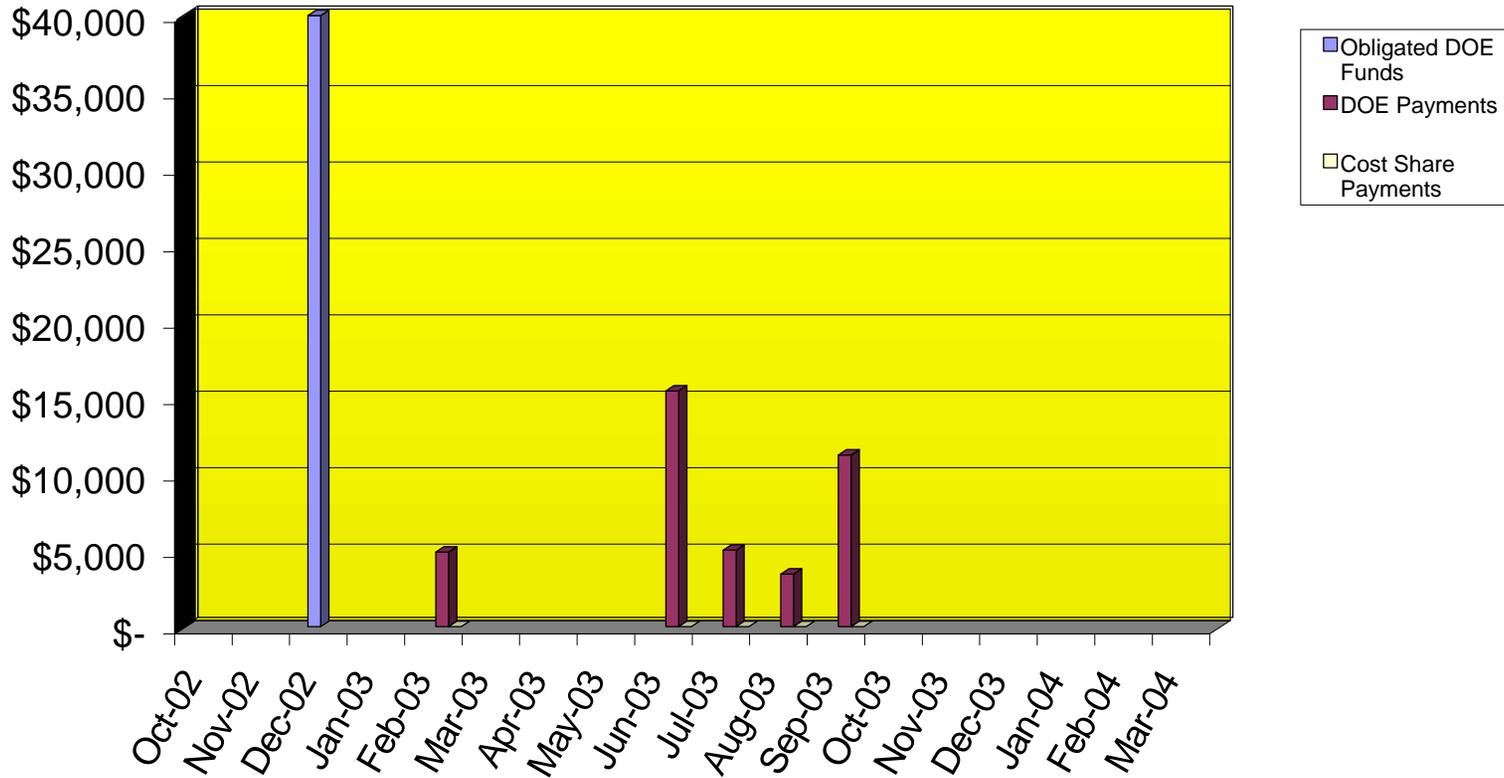
- Conduct sidewall regression measurement.
- Conduct furnace bottom measurement.

**Task 4. Project Management & Final Report**

- Manage work tasks and completion of final report.

## Project Cost Performance in DOE Dollars for Fiscal Year 2003

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	Oct-02	Nov-02	Dec-02	Jan-03	Feb-03	Mar-03	Apr-03	May-03	Jun-03	Jul-03	Aug-03	Sep-03
Obligated DOE Funds	\$0	\$0	\$40,000	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
DOE Payment	\$0	\$0	\$0	\$0	\$4,891	\$0	\$0	\$0	\$15,429	\$5,001	\$3,439	\$11,240
Cost Share Payment	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0

	Oct-03	Nov-03	Dec-03	Jan-04	Feb-04	Mar-04	PFY*	Cumulative
Obligated DOE Funds	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$40,000
DOE Payment	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$40,000
Cost Share Payment	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0

Approved DOE Budget:	\$40,000
Approved Cost Share Budget:	\$10,000
Total Project Budget:	\$50,000

\* Prior Fiscal Years

## University of Missouri - Rolla 02GO12050

ID	Task Name	Start	Finish	02		2003			
				Qtr 3	Qtr 4	Qtr 1	Qtr 2	Qtr 3	Qtr 4
1	Design & Construct Radar Equipment	Mon 9/2/02	Fri 5/30/03			100%			
2	Test Bed Trials	Mon 9/2/02	Tue 7/15/03			100%			
3	Trials in Commerical Settings	Mon 9/2/02	Fri 8/1/03			100%			
4	Project Management & Final Report	Mon 9/2/02	Fri 8/29/03			100%			