



# HotEye® in Steel Rolling

*– About the HotEye® RSB System*



*Presented by*

**OG Technologies, Inc.**

*DOE Web Cast*

*January 29, 2009*

**OG Technologies, Inc.**, 4300 Varsity Drive, Suite C, Ann Arbor, MI 48108, 734-973-7500, 734-973-1966(fax)  
Contact@ogtechnologies.com, www.ogtechnologies.com



# OG Technologies, Inc.

## Mission:

To substantially enhance the productivity of our steel customers by significantly improving process control and quality resulting in dramatic reduction scrap, energy costs and emissions through the application of our patented and proprietary technologies.



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# HotEye® RSB



**An in-line surface inspection system for the rod and bar steel market**



## **Capable of:**

**Full Coverage**

**Automatic Detection**

**Analytical**

**Interactive**

**Flexible**

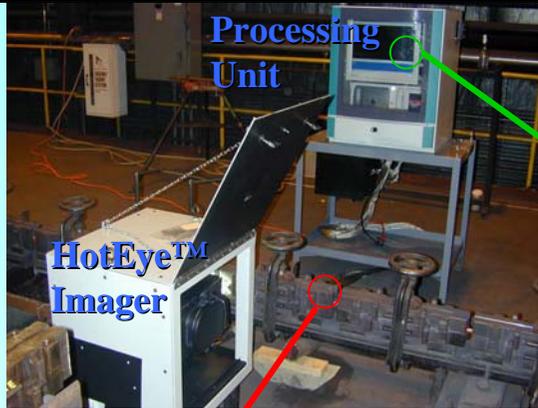
**Immediate Visual Feedback**



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# HotEye<sup>®</sup> RSB

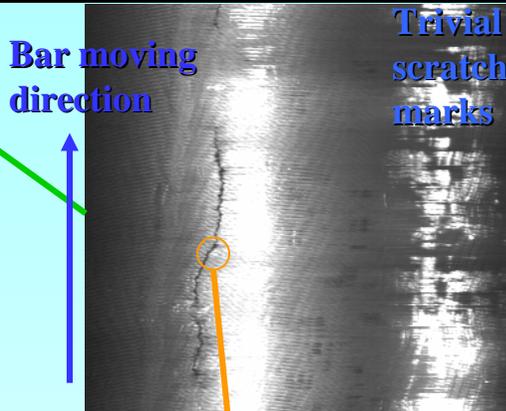


Processing Unit

HotEye<sup>™</sup> Imager



Hot Rolled Bar

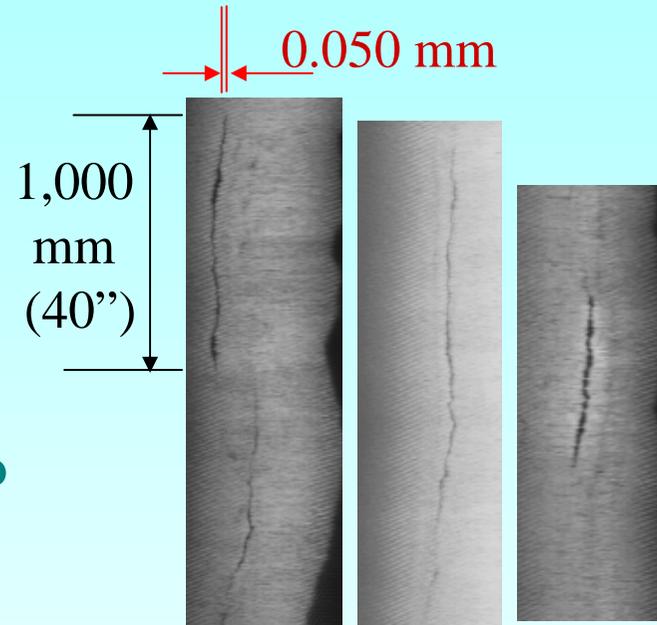


Bar moving direction

Trivial scratch marks



Efficient algorithm to detect and classify the real defect



Samples of Detected Defects

- Diameter: 5 mm to 200 mm
- Temperature: up to 1,100 °C
- Speed: 1 m/s to over 110 m/s
- Length: up to 14 Km
- Defect CD: as small as 0.025 mm
- Others: water, dust, vibrations, impacts

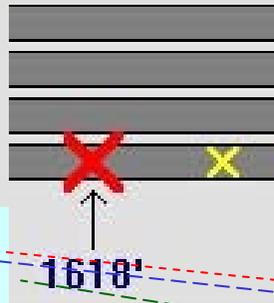
Up to **24GB** image per minute



# HotEye® BarView



Bar ID: 188589-493978-1743-32, recorded on Jan 29, 2004 at 10:58 AM  
 Material grade: N/A  
 Bar diameter: 49/64"  
 Number of defects: 3  
 Overall bar score: 88



188589-493978-1743-32.bar:1 - BarView

File Edit View Database Help

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 Bar diameter: 49/64"  
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 Overall bar score: 88

Severity:  
 X Low  
 X Medium  
 X High

Type	Length	Severity	Conf
X sample	36.5 "	0	0
X sample	36.5 "	0	0
X sample	36.5 "	0	0
X sample	36.5 "	0	0
X seam	21.7 "	58	67
Y seam	8.6 "	42	68
Y seam	10.1 "	37	62

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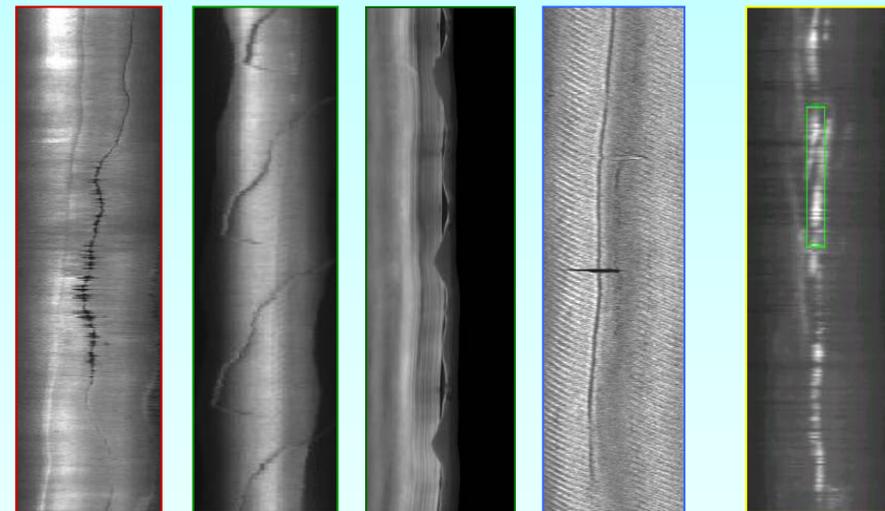
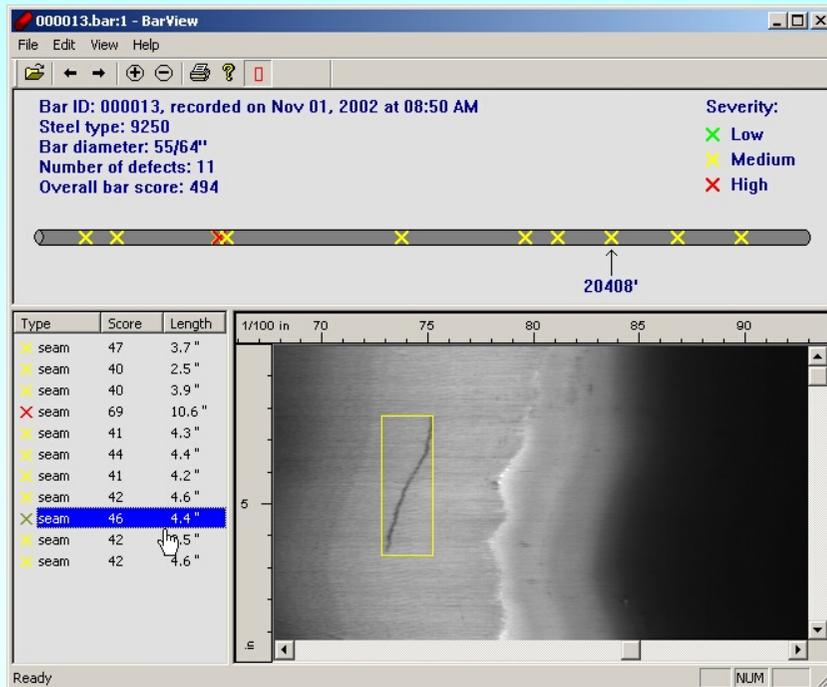


# HotEye® Data

## Verifiable!

- Whether HotEye® functions properly.
- What the detection is.

The X marks can be reviewed:



**For High Detection Accuracy  
& Effective Process Control**



# Deployment to Date



***14 mills installed***

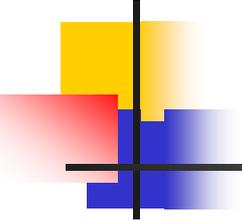
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# Process Metrix Mobile Laser Contouring System (LCS) for Converter Lining Thickness Monitoring



Process Metrix  
6622 Owens Drive  
Pleasanton, CA 94588  
USA

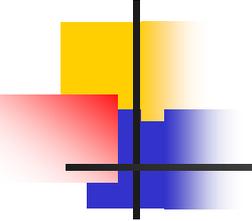




# Process Metrix – A History of Instrumentation Development

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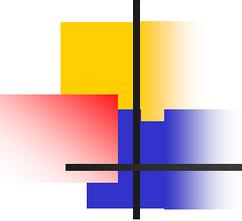
- Insitec Measurement Systems –
  - Founded in 1985, laser-based particle size instruments
  - Close associations with gov't labs, \$5M in government research
  - 1993 - development of instrumentation for steel industry: Two color pyrometry (temperature), spectroscopy (off-gas control), range finding (refractory thickness measurement)
- Insitec sold to Malvern, PLC in 1997 –
  - Principles stay on to support technology transfer
- Process Metrix started January, 2000 -
  - Same group of people
  - Focus on steel sensors, particles, continued gov't funding
  - LCS released in 2001
  - Next-gen particle sensor released in 2004
  - Sales growing rapidly as market penetration increases



# Total Control of All Aspects of our Product

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- A talented group-
  - Engineering staff include:
    - Ph.D, M.S. and B.S. degreed mechanical and chemical engineers
    - Electronics technicians
- Process Metrix designs and builds its own:
  - Software - Microsoft Windows-based
  - Hardware –
    - 3-D CAD development tools, including Finite Element Analysis (FEA)
    - San Francisco Bay area job shops fabricate machine parts
  - Electronics –
    - In-house schematic and board layout tools, with modeling capability
    - Boards fabricated using state-of-the-art tooling in Silicon Valley
- Each instrument is hand assembled in our factory, tested, and verified following strict quality control procedures

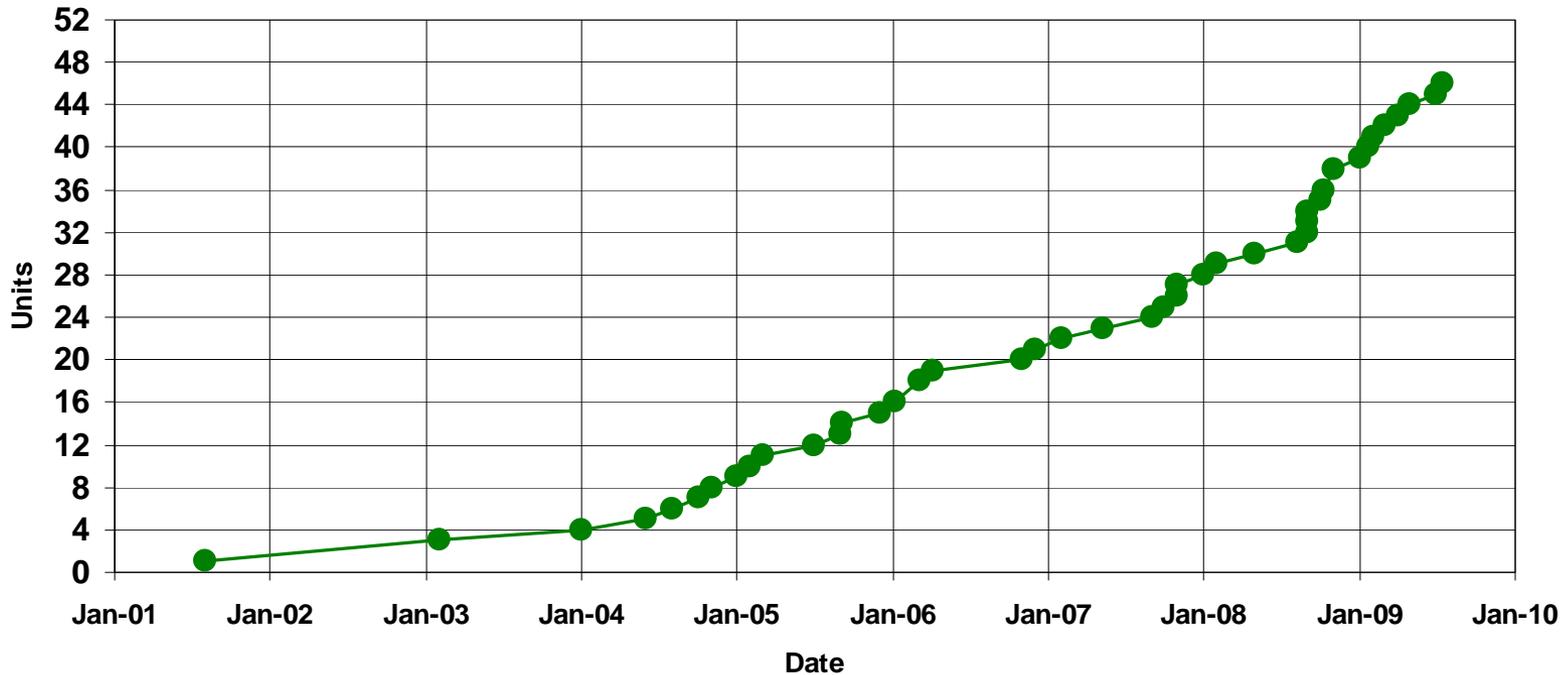


# Project Made Possible by Support From DoE and AISI

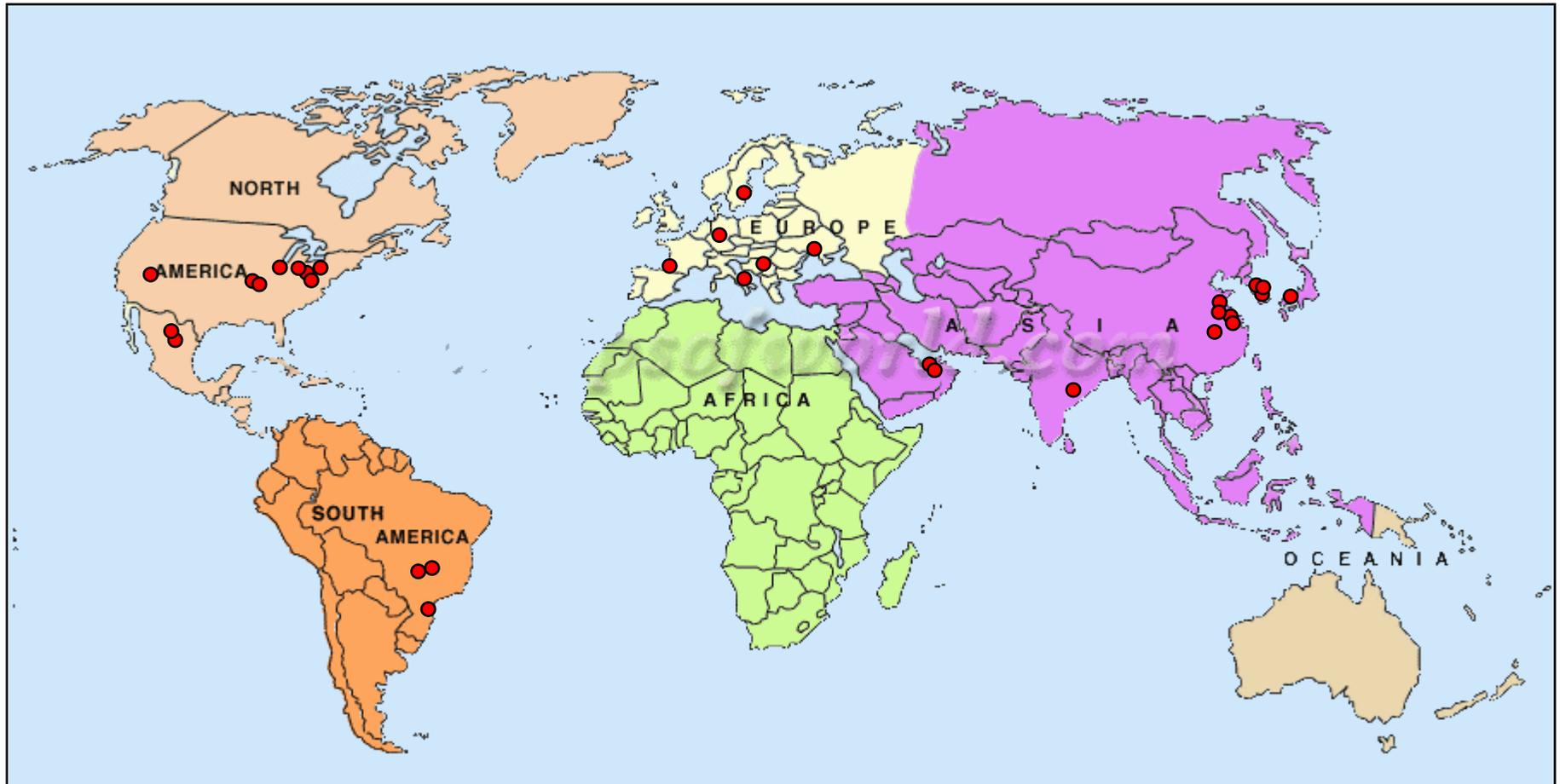
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- Project Funded by Process Metrix, DoE and AISI
  - Direct project development funding
    - Resulted in delivery of first commercial prototype at US Steel Granite City Works
  - Test and evaluation of two systems at US Steel-ET
    - Mobile cart systems for converters
    - Installed 2003
    - These units still fully functional
  - Test and evaluation of ladle system at REP-Lorain
    - Working closely with Berry Metal Company and Resco Products
    - Installed 2005
    - LCS data now being used for process decisions
  - Process Metrix continues to invest in software, mechanical and electronic design improvements, feature requests, etc.

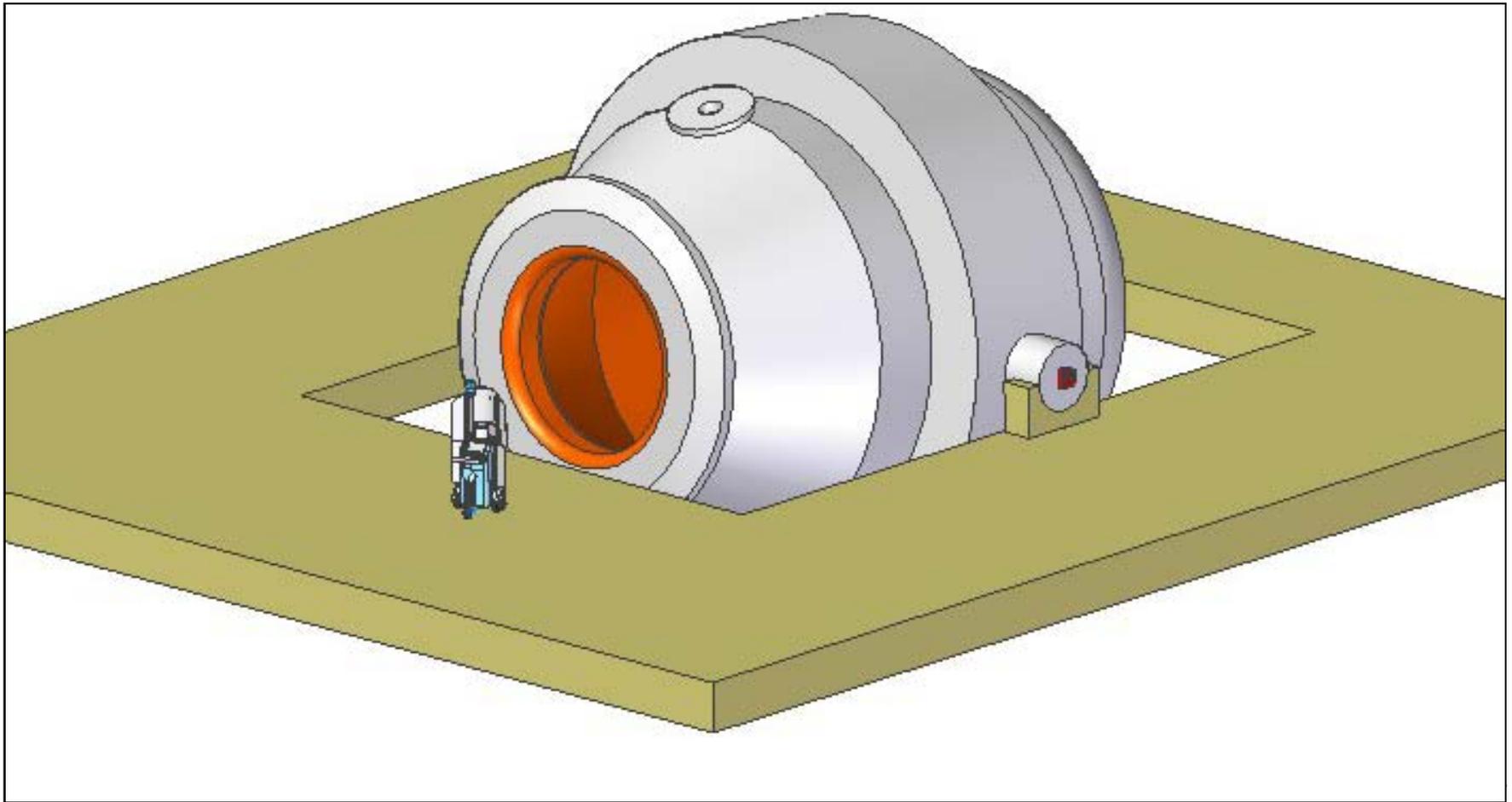
# LCS Sales Show Rapid Market Uptake



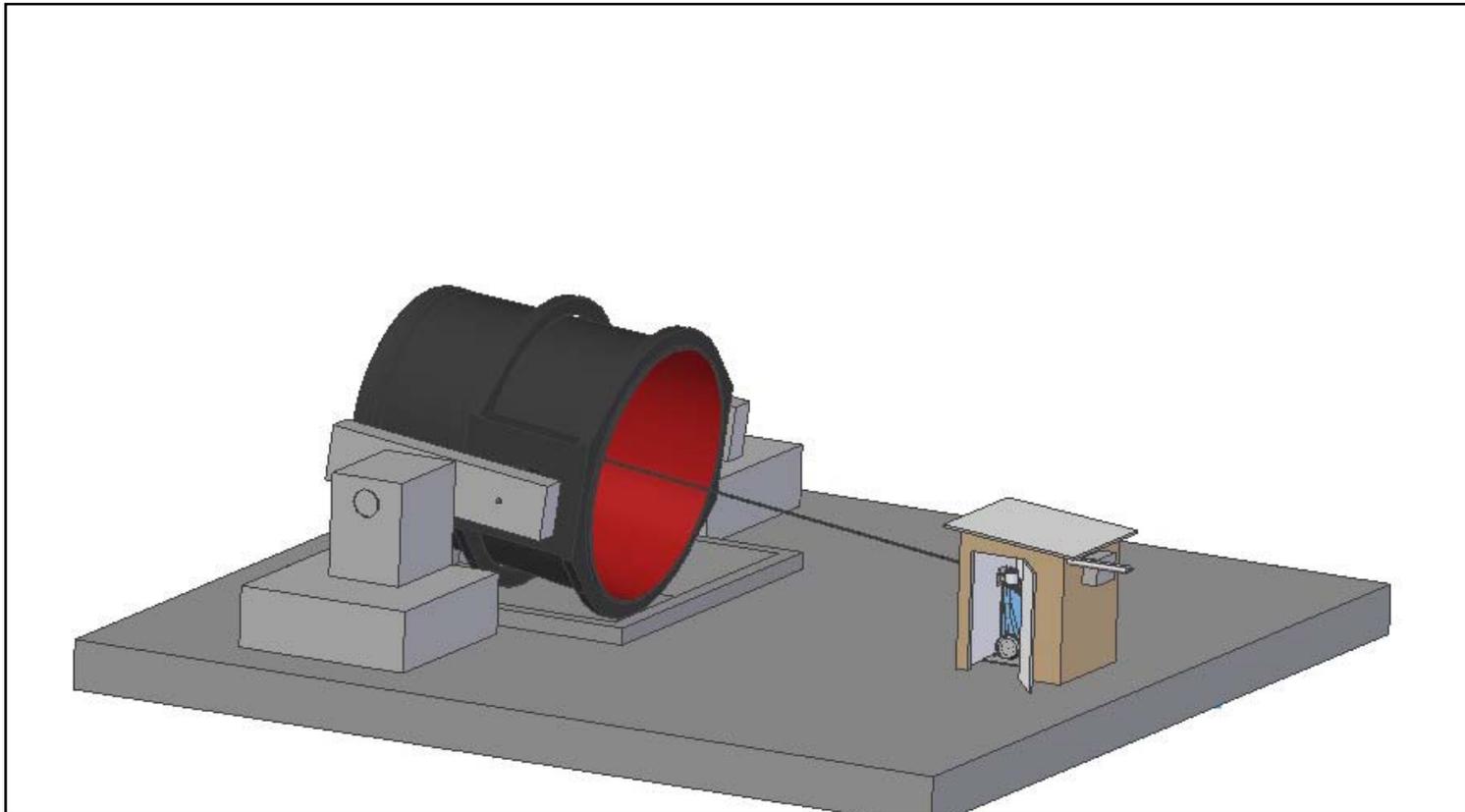
# A World-Wide Installed Base Serves Converters, Ladles, EAF's and AOD's



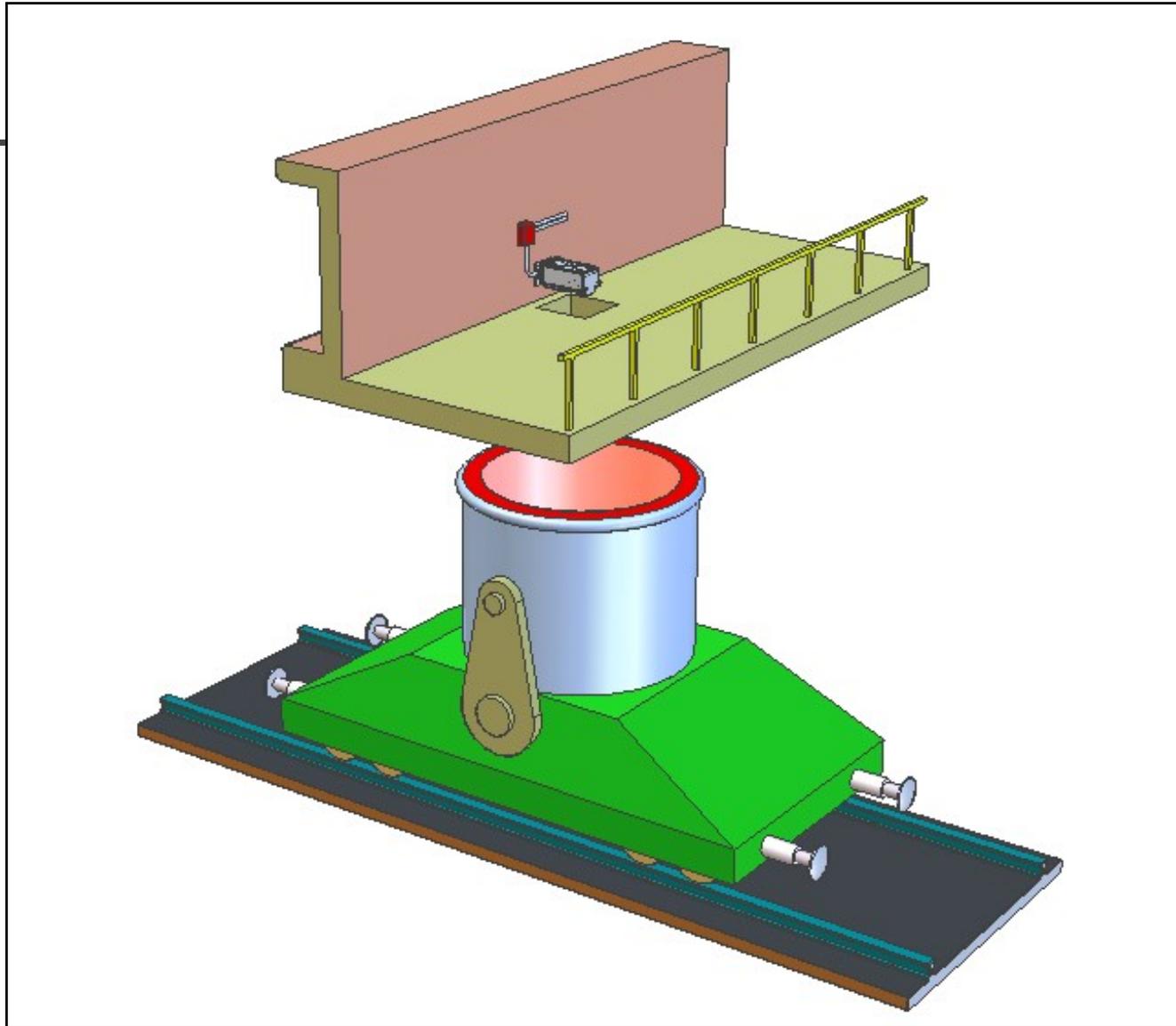
# Basic Oxygen Furnace – Fast Measurement of the Converter for Process Control



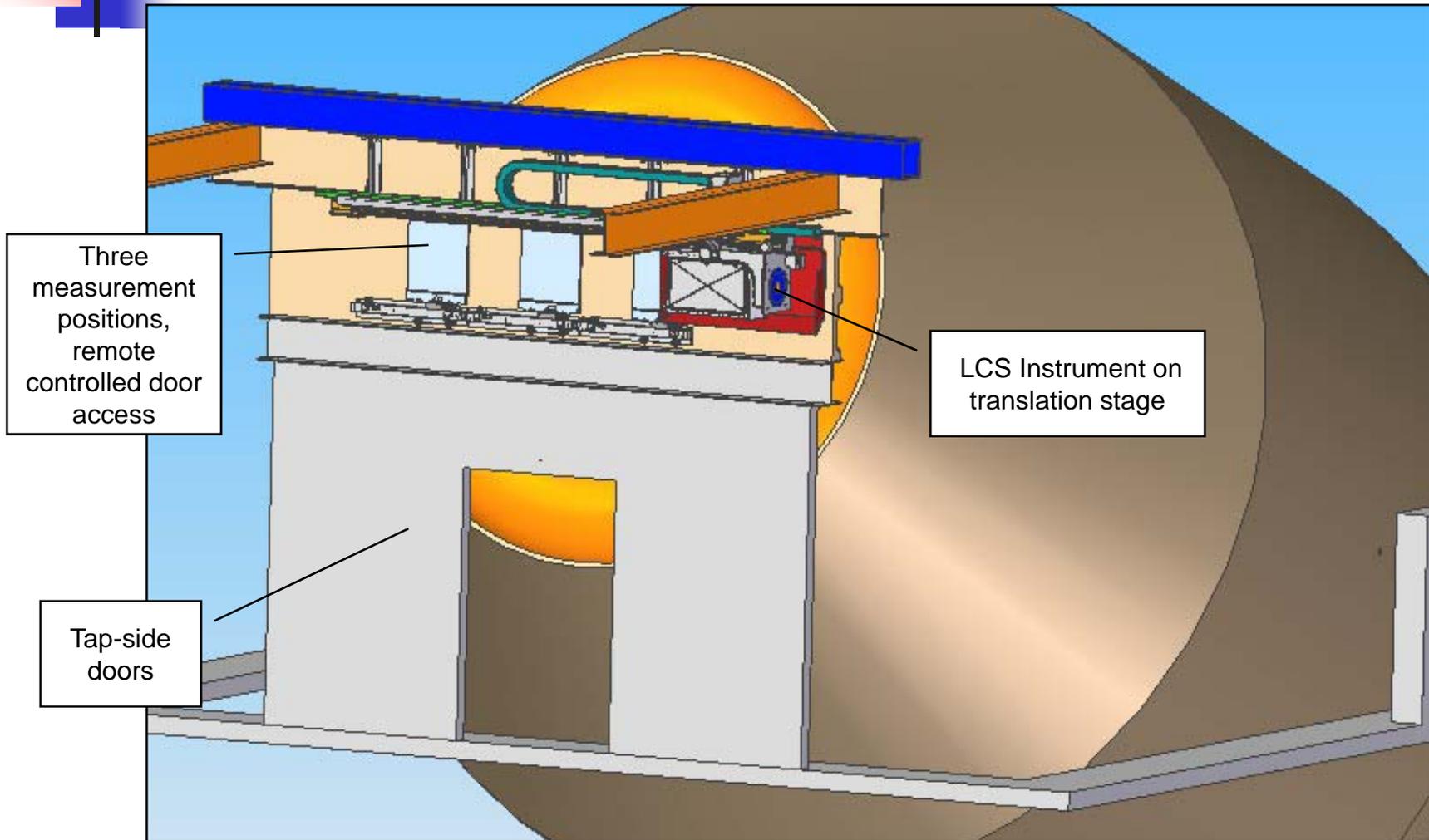
# Installation at Slide Gate Maintenance Station (Bao Steel, Posco, REP)



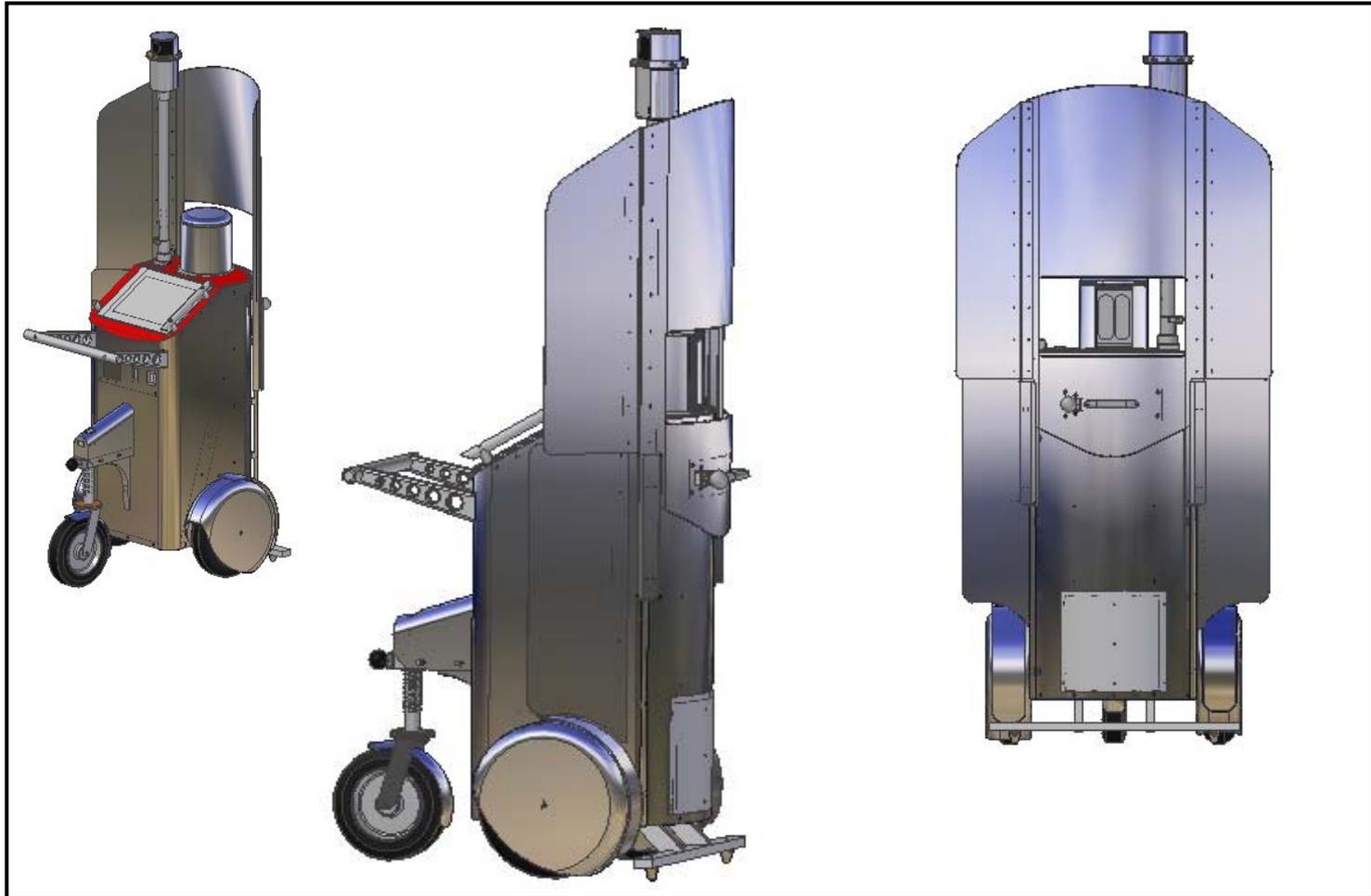
# Measurement on Transfer Car (DEW, POSCO)



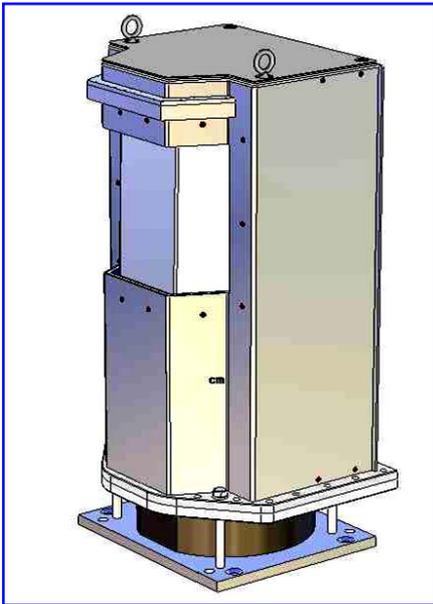
# Basic Oxygen Furnace – Fixed-Position Installation for “always on” Measurements



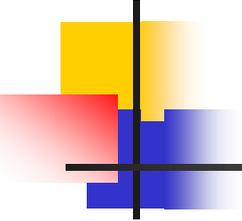
# Mobile Cart Version 6.0 – Simple Construction, Robust design



# Fixed Position System for Ladle Measurement



- Thin lining in ladle requires high accuracy ranging head (5 mm uncertainty)
- Must know position of ladle to similar accuracy
- Installation location must include the current ladle work flow:
  - Slide gate maintenance station
  - Transfer car
  - Pre-heater station
- Reference measurement of newly-bricked **HOT** ladle crucial for accuracy
- Campaign manager (software) tracks each ladle to allow assessment of ladle thickness over time



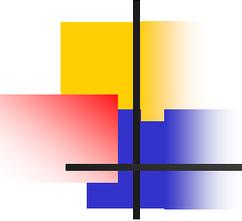
# Achieving Fast Measurement Time with the Mobile Cart

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- Purpose-built Hardware and Software For The Mill Environment-
  - Laser Tracking System automatically locates cart for each setup
  - Radio link automatically sends converter tilt information to cart from high accuracy inclinometer
  - Single mouse-click measurement control
  - Fast range measurement head - **8,000 samples/second**
  - Fast data analysis (1-3s)

## **GOAL: SINGLE SETUP MEASUREMENT AT ONE converter TILT**

- Measurement time - **25-30 seconds per setup**
- Full converter characterization – **4-6 minutes at 750,000-1,000,000 points, 5 setups**

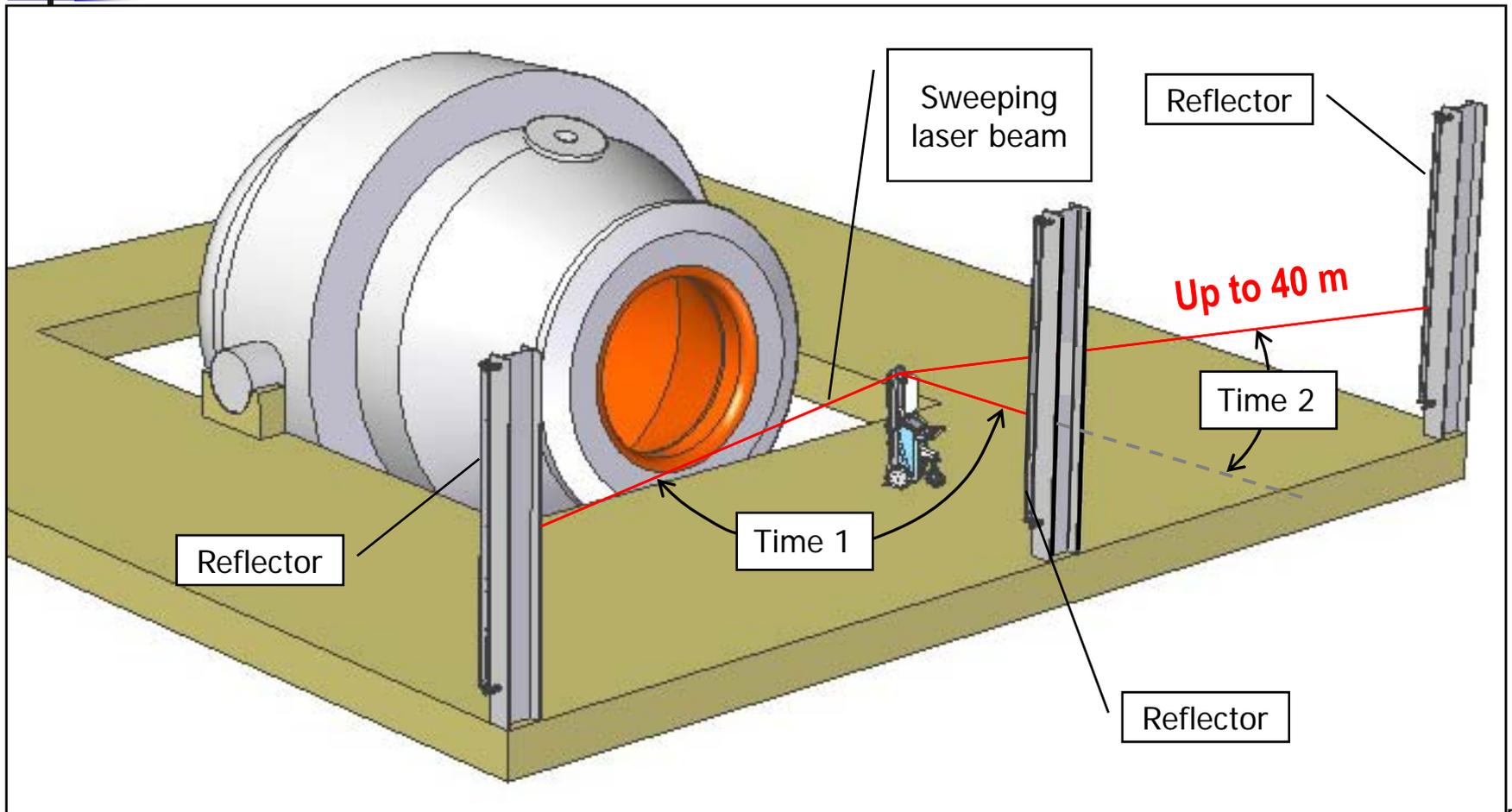


# Cart Laser Tracking System: Key to Fast, Single-Setup Measurements

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- Commercially available system used in warehouse automation applications
- Cart mounted, rotating laser beacon sequentially illuminates three reflectors located *behind* the instrument.
- Time between reflector illuminations coupled with reflector location in defined operating area determine cart position
  - Position accuracy - 1 cm
  - Heading accuracy - 0.05 degrees
  - System updates 10 times per second - **FAST**
- Patented algorithm for determining position

# Laser Tracking– Position Determined by Timing

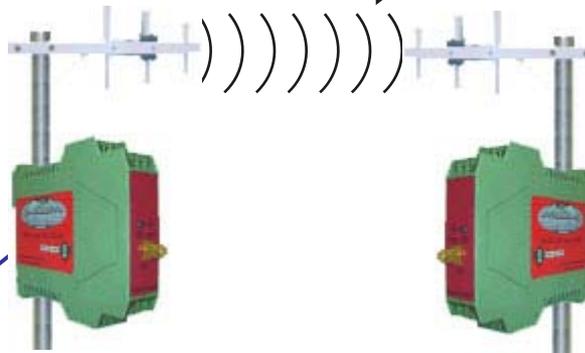


# Converter Tilt Automatically Transmitted to Cart Using RF Link



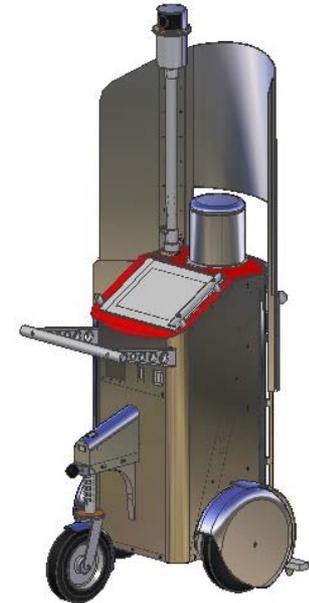
Measure

Transmit



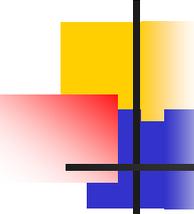
Transmitter mounted in mill

Radio Frequency (RF) Link



Laser Contouring System

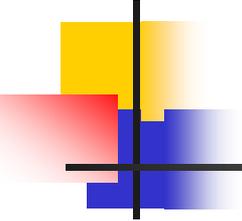
Receiver located in cart



# Comprehensive Software For Data Collection and Analysis

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- Data collection, instrument control and status indication
- Message logging
- Campaign Manager
- On-board error messaging
- 3-D data processing using triangle mesh
- Automatic outlier point removal
- Presentation of raw and reduced data
- 2-D Slice displays
- Bottom and wall contour displays
- Summary table
- Wear rate calculator
- Level 2 output
- Data export to CSV format
- Password-protected access control
- Bath height and slag height calculator
- Report output generator
- Surface temperature calibration and display module
- Configuration Manager



# Competent Service/Support

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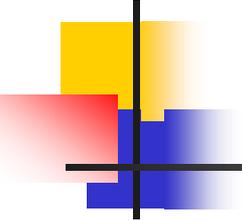
- One year warranty on all system components
- Process Metrix offers a comprehensive service/support plant
- Qualified and trained engineers provide local service and support.

Developers of the system provide service, or direct those who do

- Service plan includes:
  - Twice yearly (minimum) visits to verify performance and operation
  - Unlimited telephone and website support
  - All software upgrades (as released)
  - Replacement of all systems components that fail through normal use
  - Ongoing training at customer site



# In Summary....



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- The LCS product is engineered for mill service and has a proven reliability record
- The system provides the highest quality data in the shortest time – Industry Wide
- Software system provide advanced functions using simple user interfaces
- System is manufactured in the USA, and includes the highest quality components available
- Service and support provided locally by trained engineers from PMC