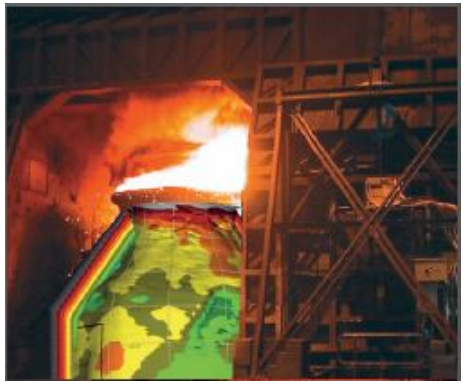



LaCam® LI-Explorer




Rolf Lamm
October 2018

MINERALS TECHNOLOGIES MiNTEQ

FERROTRON
A MiNTEQ DIVISION

Laserprofile Measurement in the Steel Industry

LaCam® - Mobile

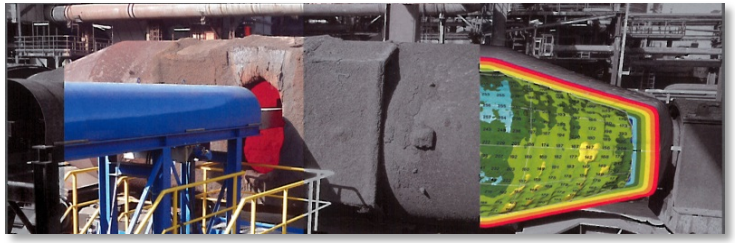
Mobile version for converters and ladles

Fixed installation for:

Converters

Ladles

EAFs



Torpedo Tadles

Open Die Forging

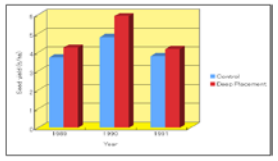
Motivation of Laser Measurement in Ladles

Why Laserscanner for Hot Ladles?

Increase of safety in a steelplant

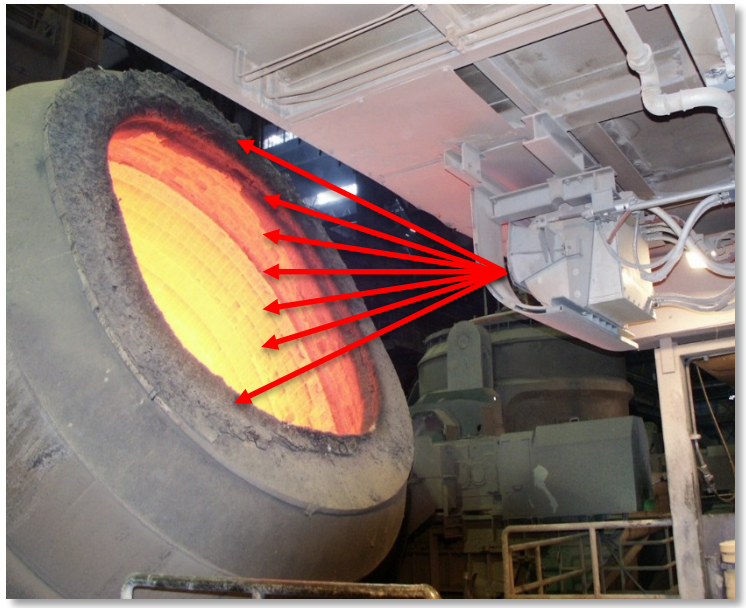
Reduction of refractory and maintenance cost

Optimization of process and logistics

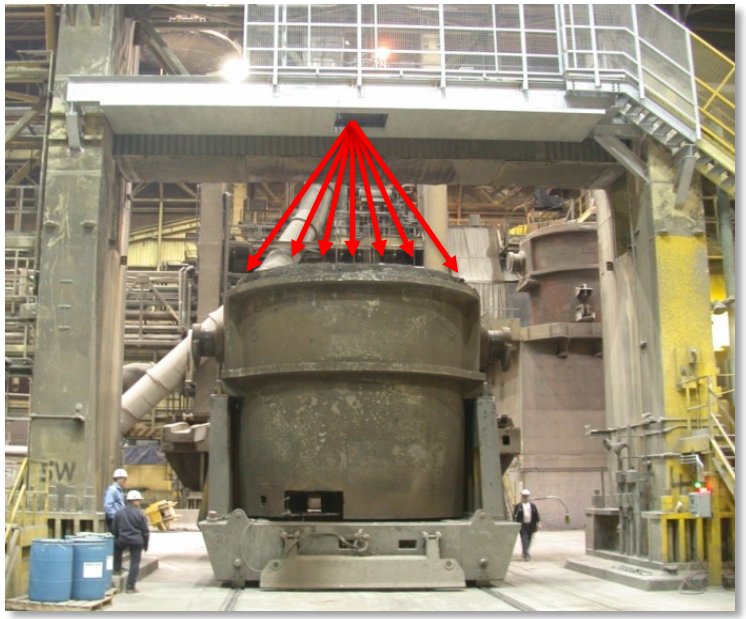


Increase of yield

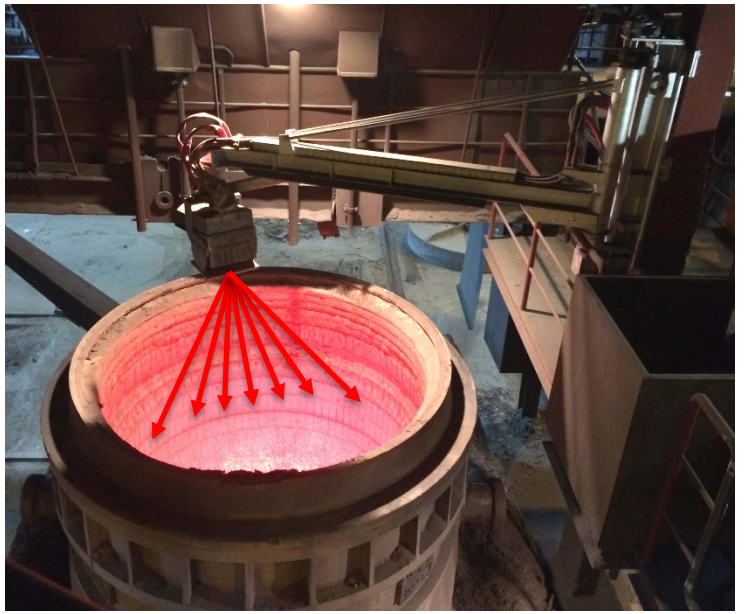
Examples of Current Laser-Ladle Inspection



fixed or tiltable ladle stand



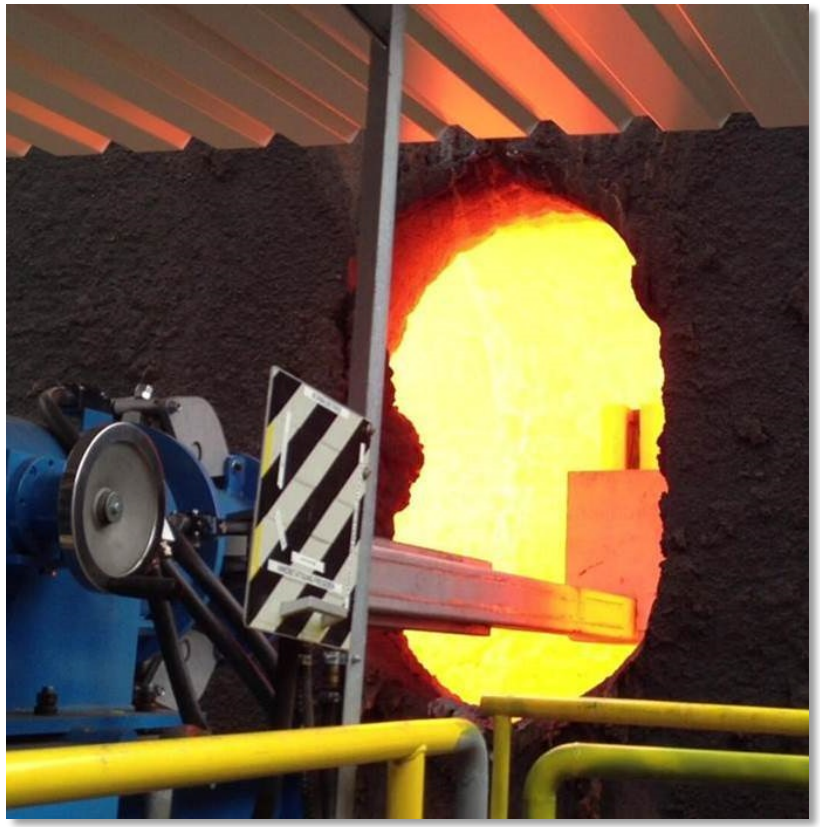
bridge over ladle transport car



swinging arm above ladle

If the mouth of the ladle is “clean” and no skull is built up you can have good results from the entire Ladle-Refractory lining although the laserscanner is in front of the ladle mouth. But hidden areas cannot be measured and leads to a remaining risk.

New Developed LaCam® LI-Explorer

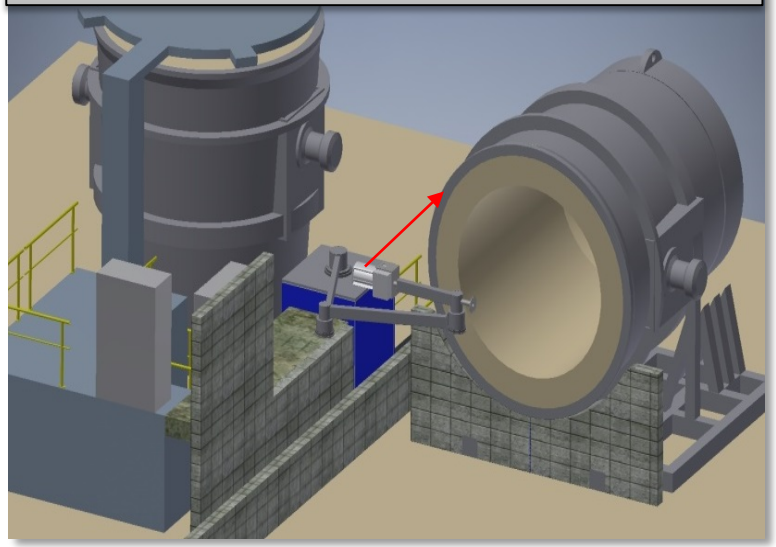


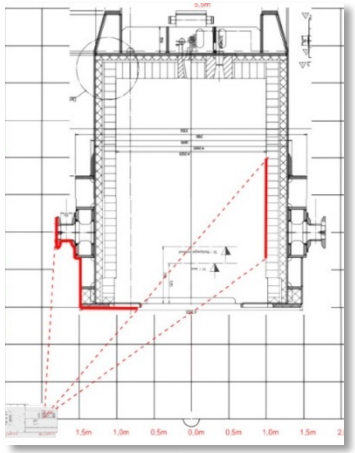
Patented measurement method was further developed to measure ladle refractory lining in hot condition directly after tapping from inside the ladle

The method of immersing a laserscanner into a hot confined space was already introduced with the LaCam®-Torpedo which measures inside the hot torpedo ladle.

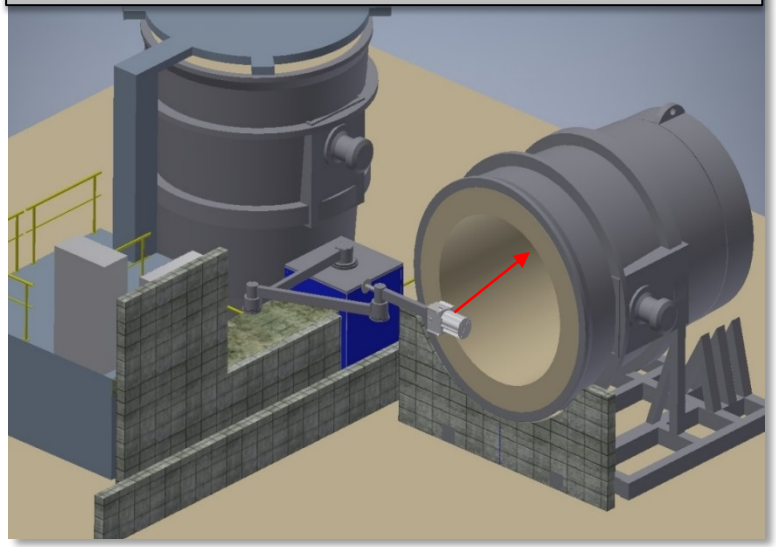
Measurement Procedure

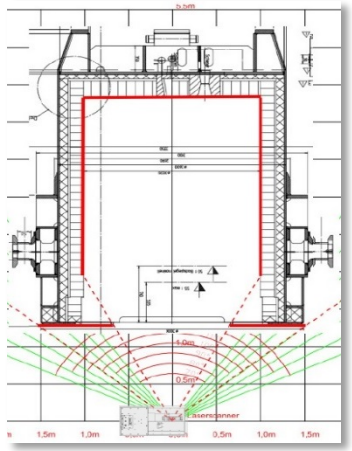
Positioning-Scan on outer ladle shell



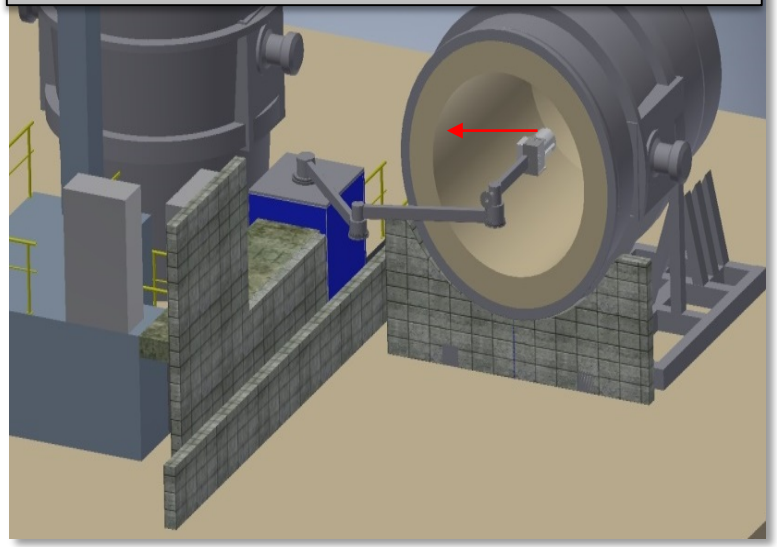


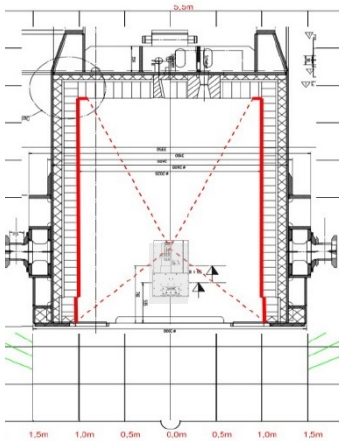
Bottom-Scan from outside





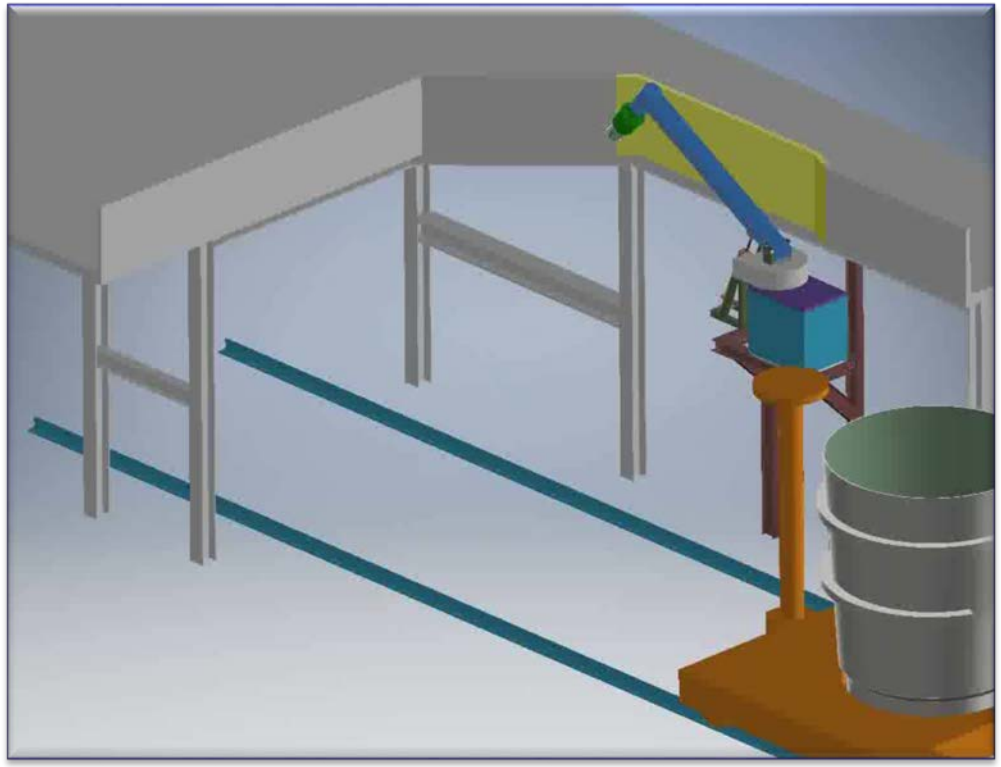
Centerposition-Scan 360° inside ladle



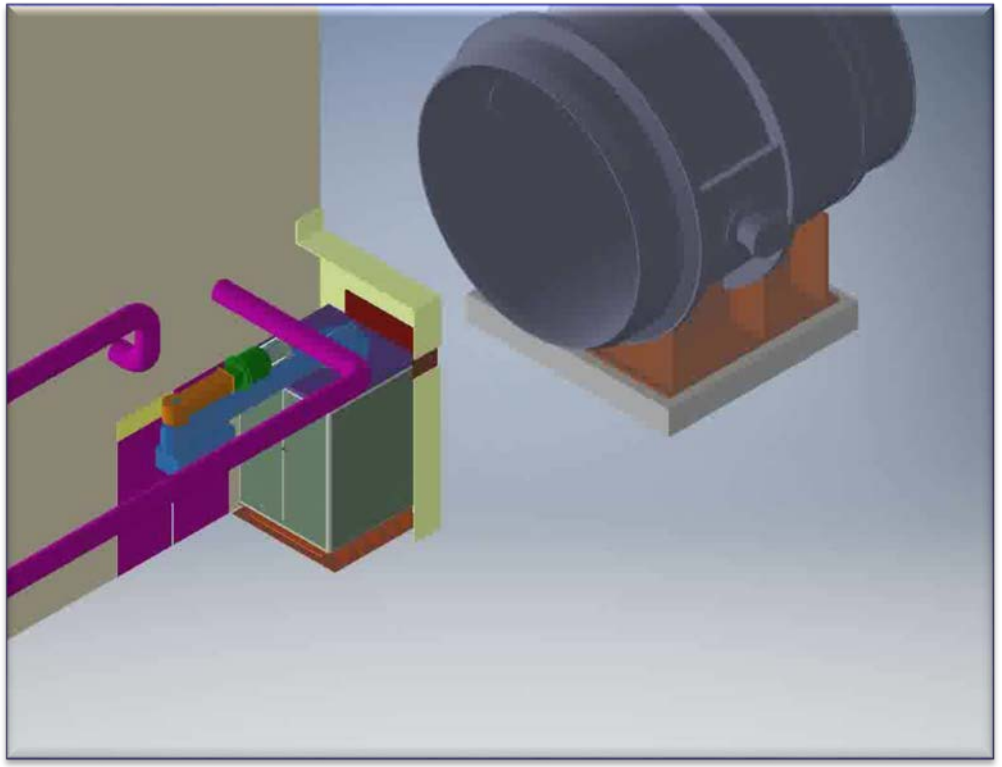


Examples of LaCam LI-Explorer Applications

Ladle in Vertical Position



Ladle in Horizontal Position

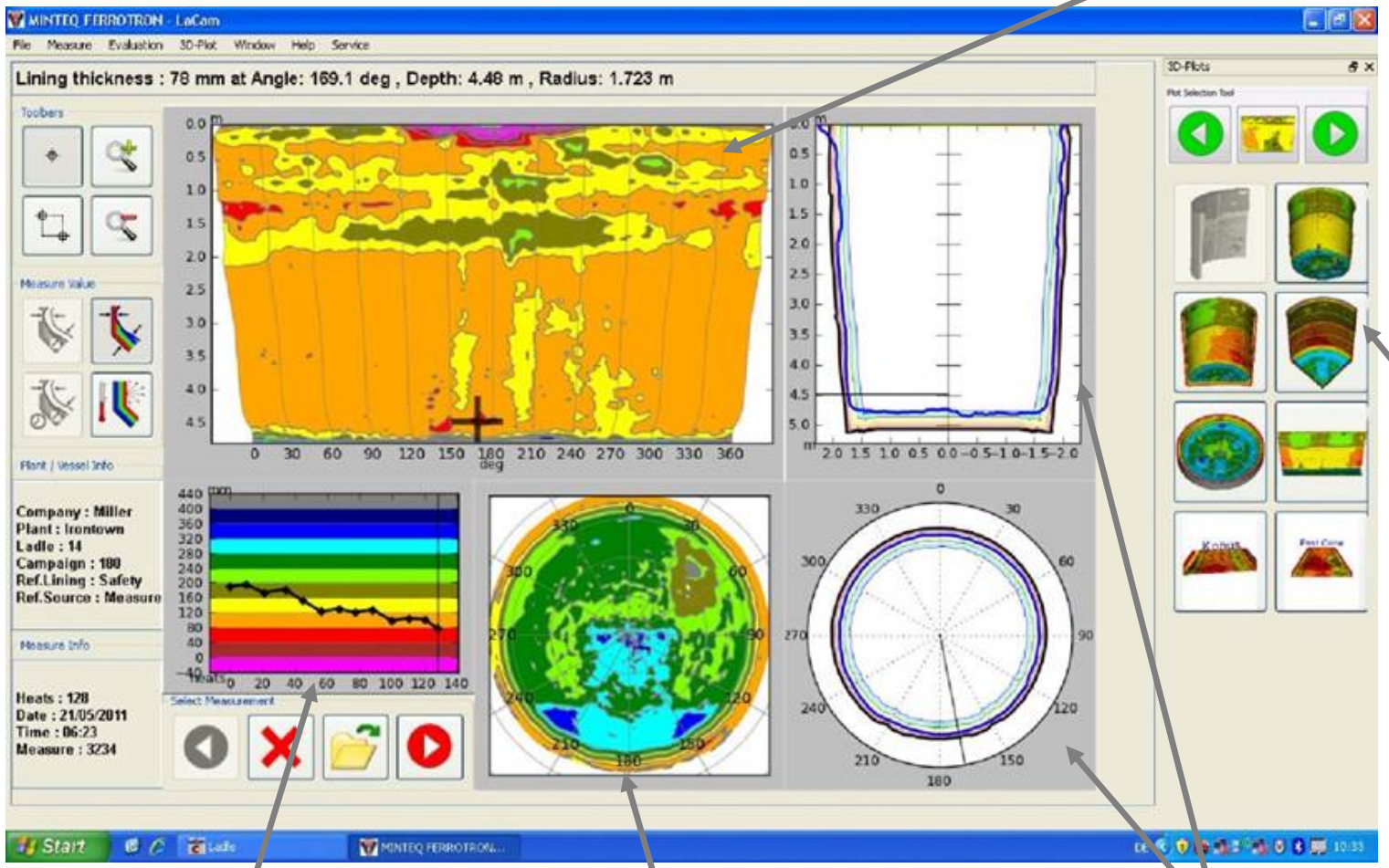


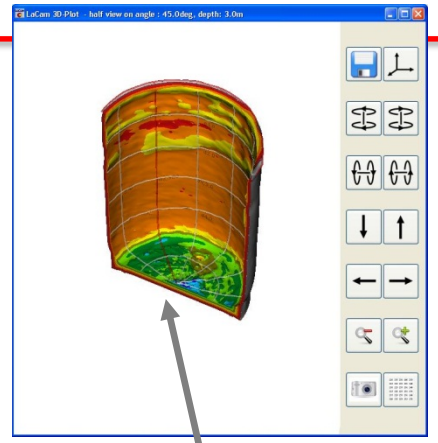
Klick on picture to run animation clip

Versatile 2D and 3D Result presentation for Ladle Application

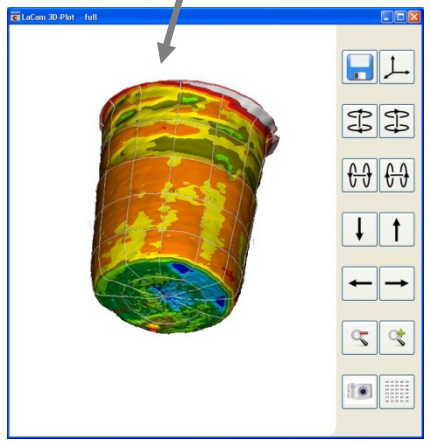
Ladle Refractory Thickness- ,Wear- and Wearspeed- Measurement

Wall





Examples of 3D presentation

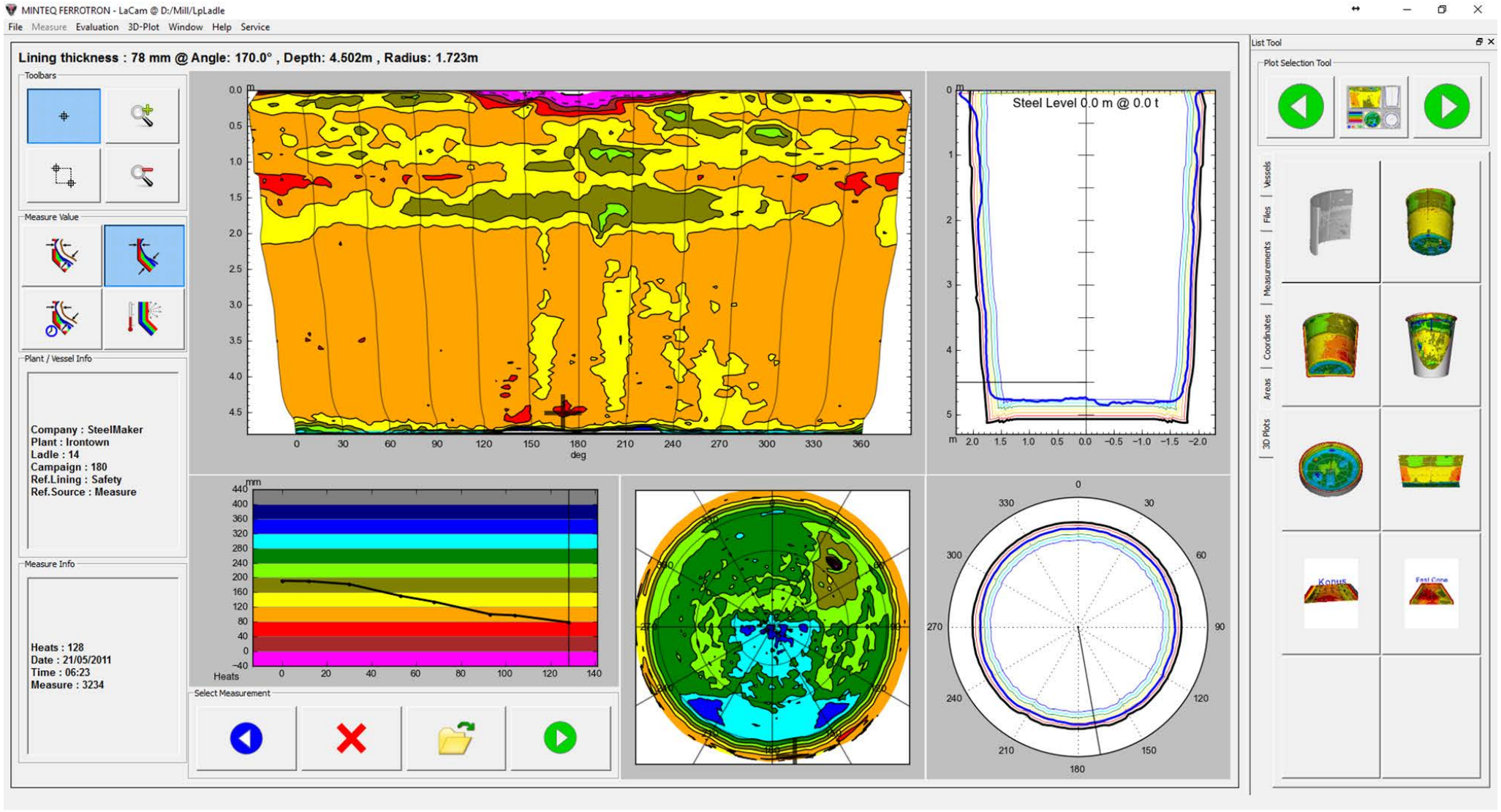


Trend and Tendency Analysis

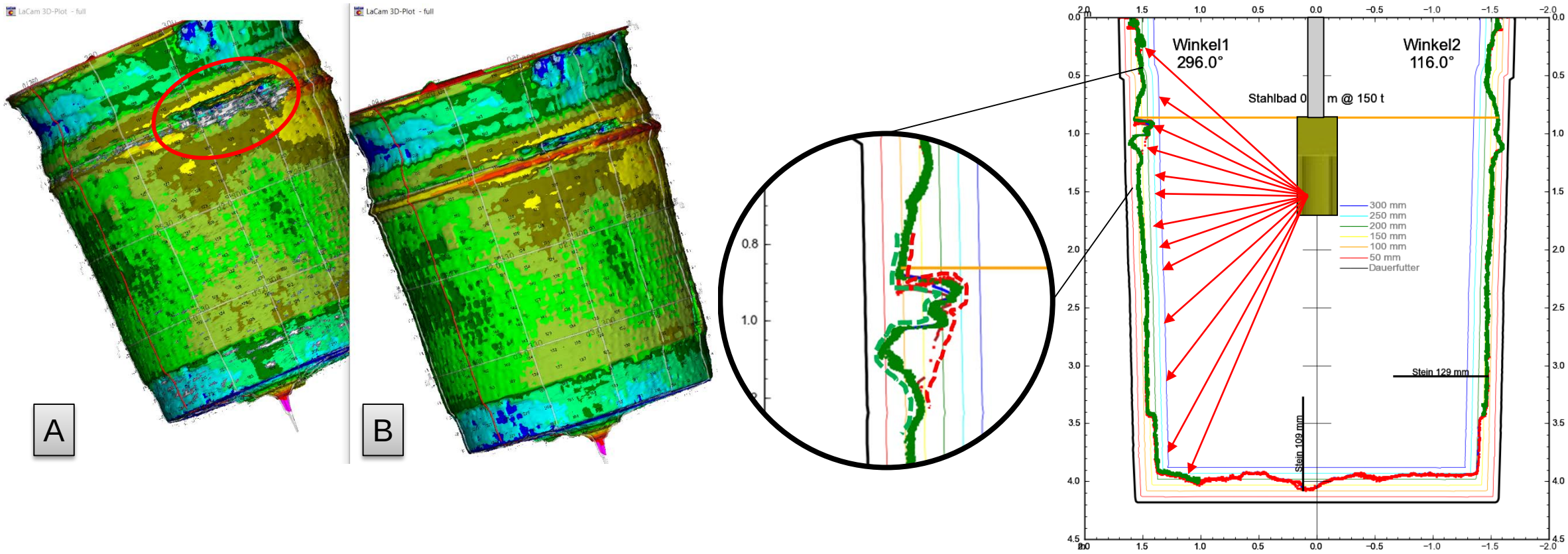
Bottom

Sectional and Horizontal 2D Cut

Evaluation and presentation of the results

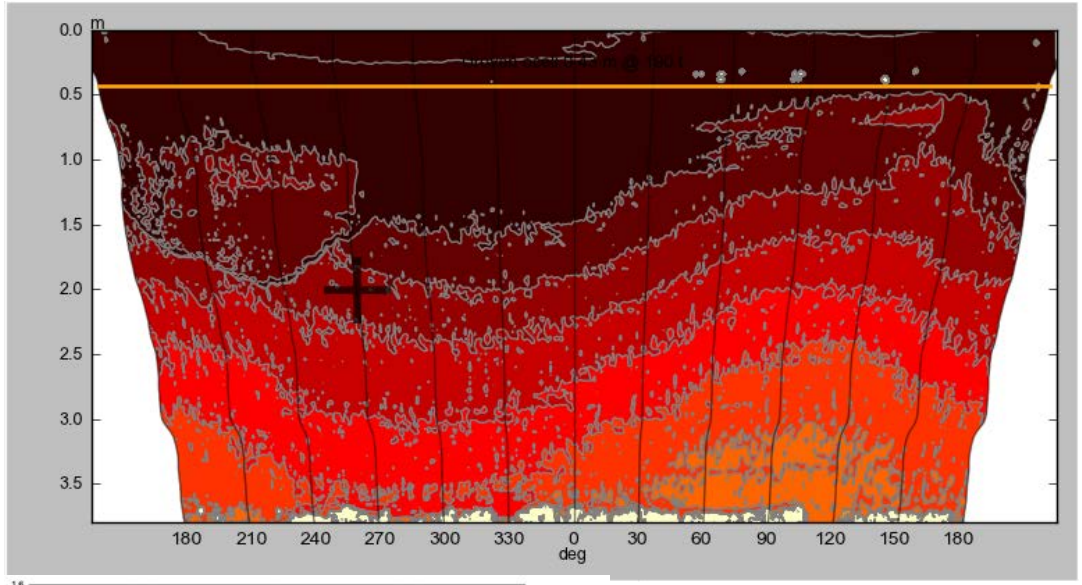


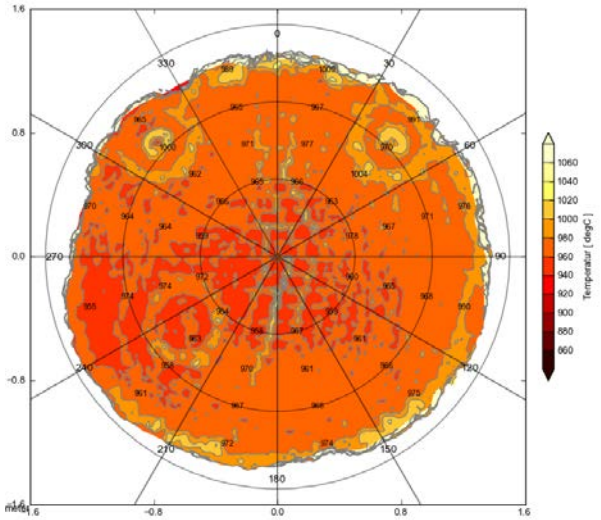
Measurement from outside vs. inside

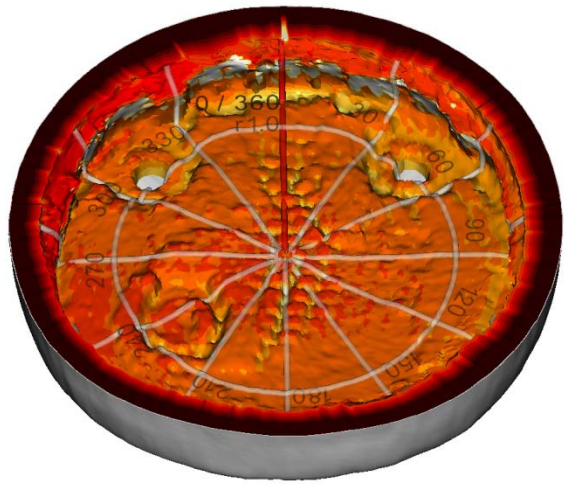


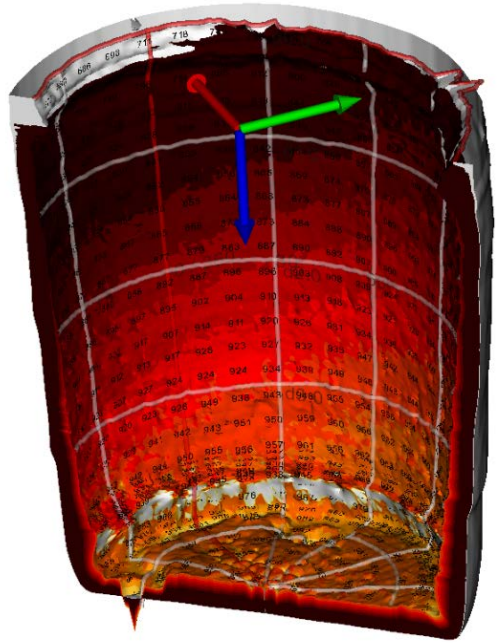
Refractory thickness measurement with laserhead position outside (A) and inside (B)
Not measured areas in the slagzone are white spots (A)
fully measured slagzone (B) shows dangerous thin lining in red

Pyrometric Temperature Measurement



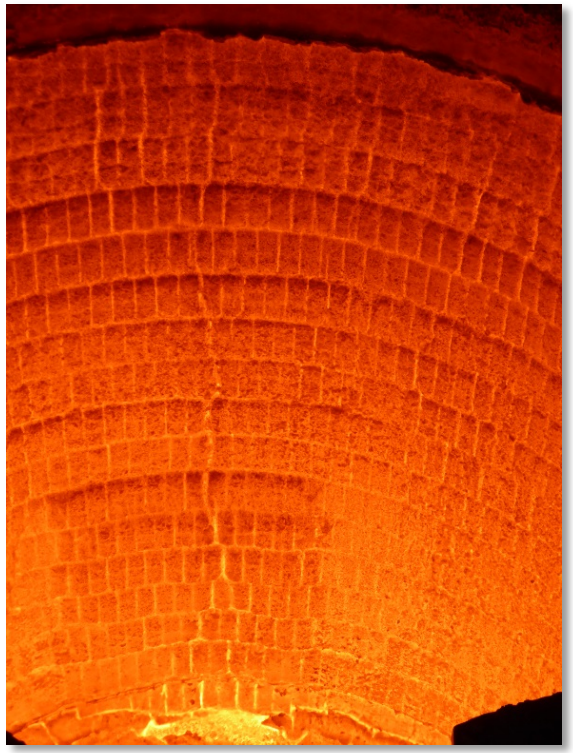




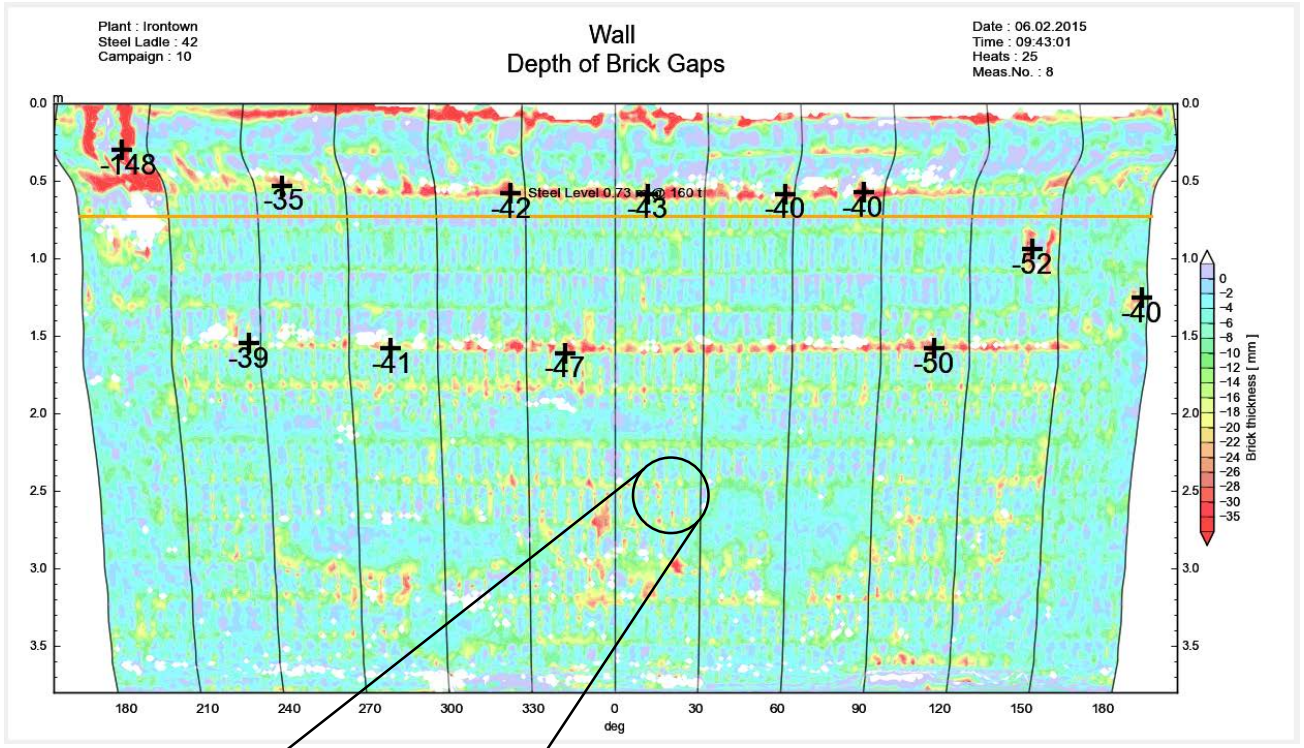


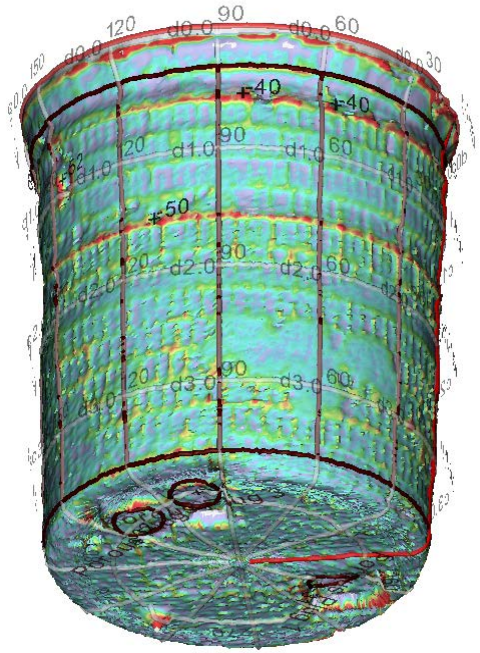
Simultaneously to the lining thickness the system measures the surface temperature of the lining with a high density of data collection (one measure point per laser shot). With this additional temperature profile information the system provides non-uniform temperature distribution of the ladle-lining and hot spots.

Gap and Crack Detection



Crack and Gaps in a ladle

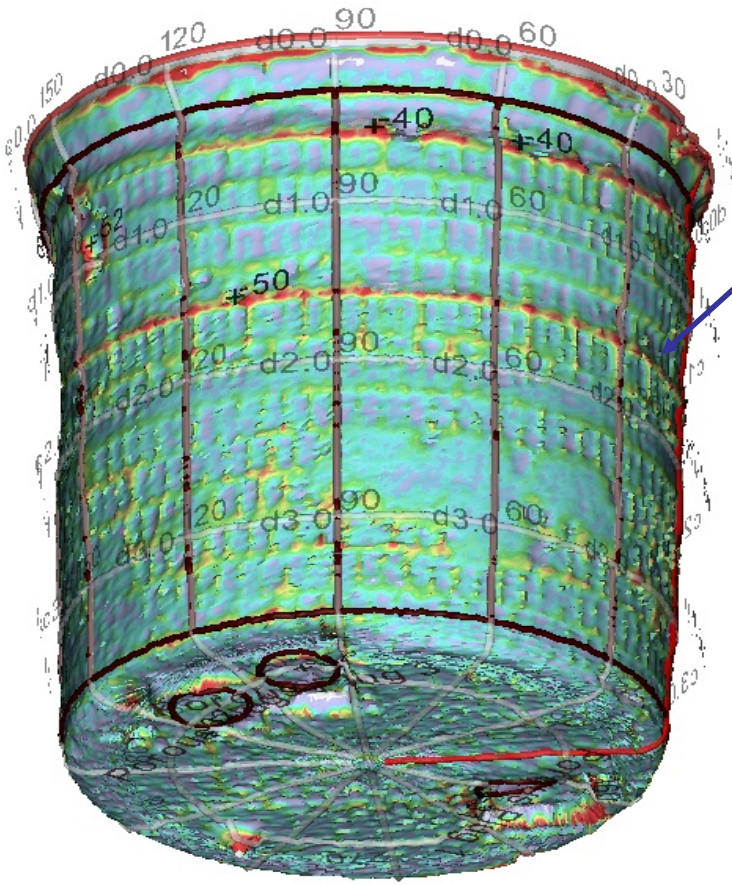


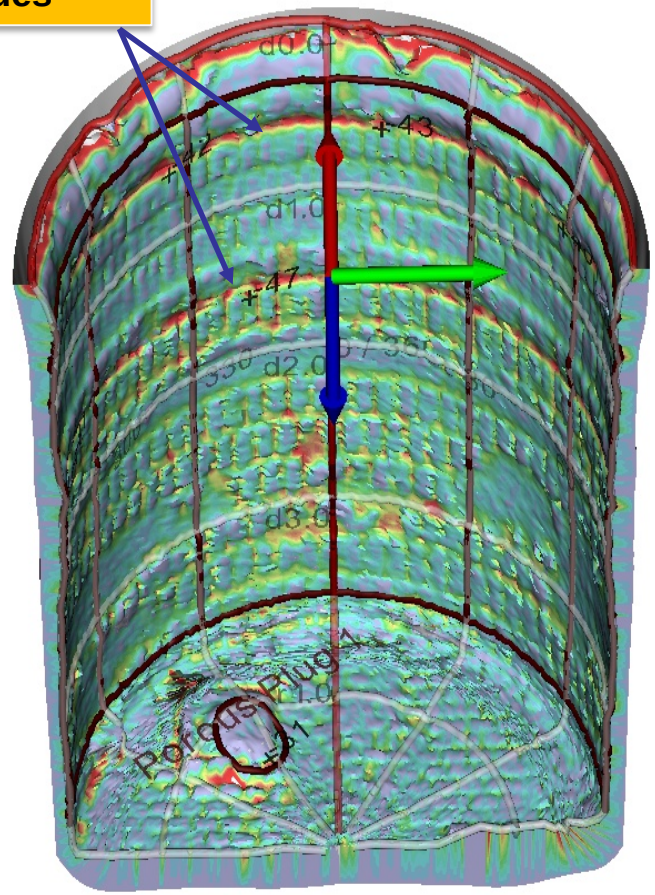


Performed data processing is a special 2D peak finding algorithm which has some similarities to image processing functions. In a combined evaluation of brick thickness-, surface temperature and Laser Echo Amplitude a gap or crack in the lining can be determined

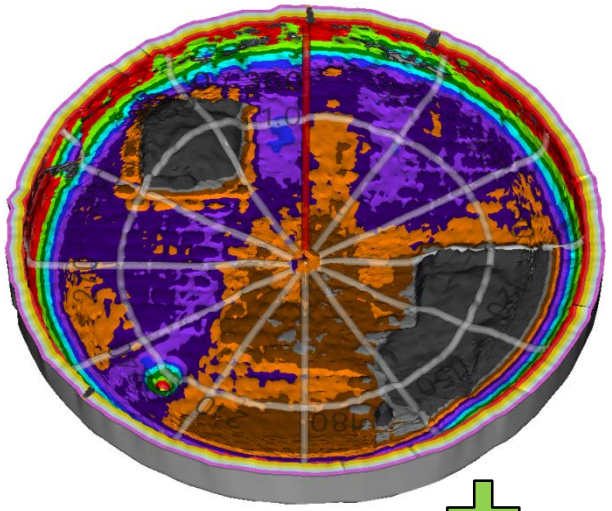
3D - Gap contour plot of ladle / view from outside w/o steel shell and cut in half from inside

Ladle wall with gaplines (red) and gap values

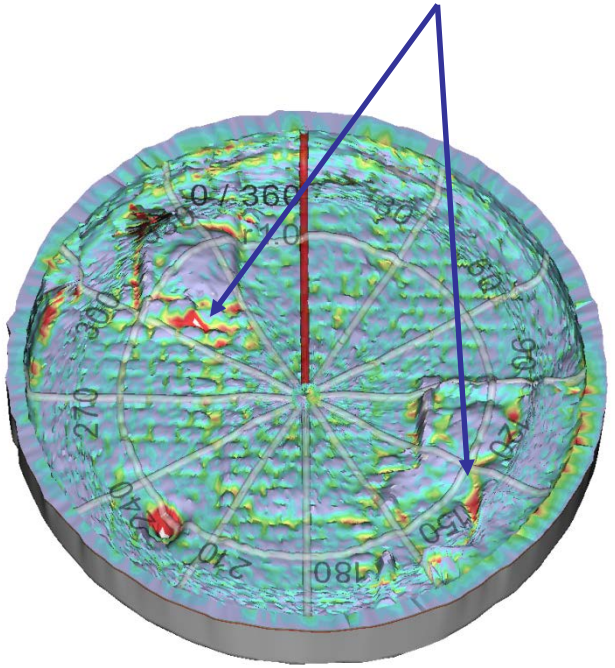




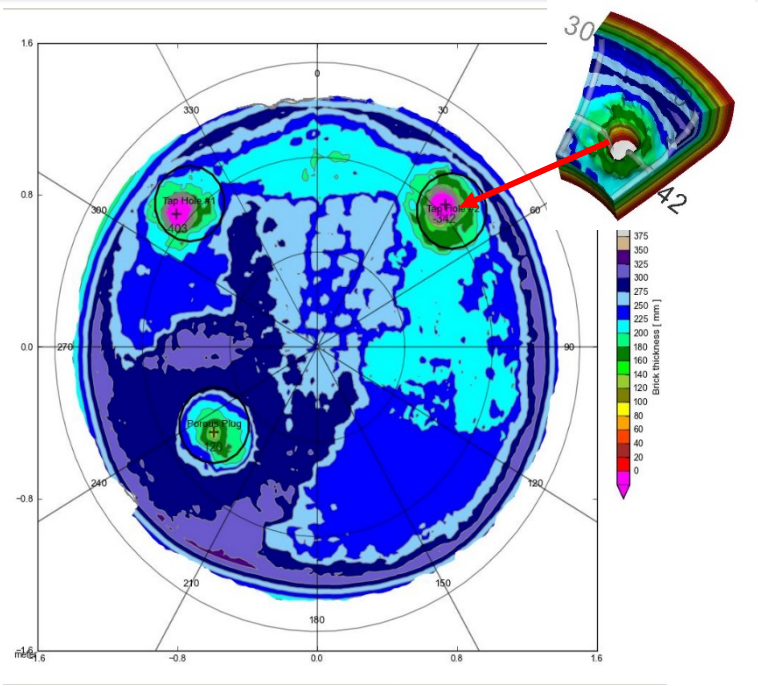
3D - Gap contour plot and Temp. plot of ladle bottom result in automatic detection of extreme points



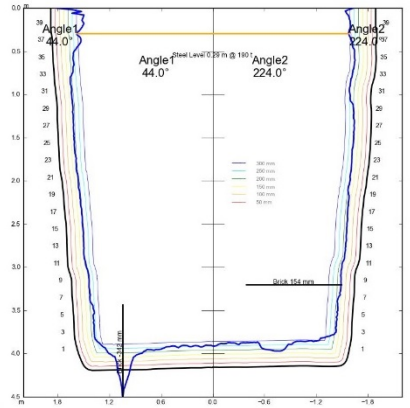
“extreme points”

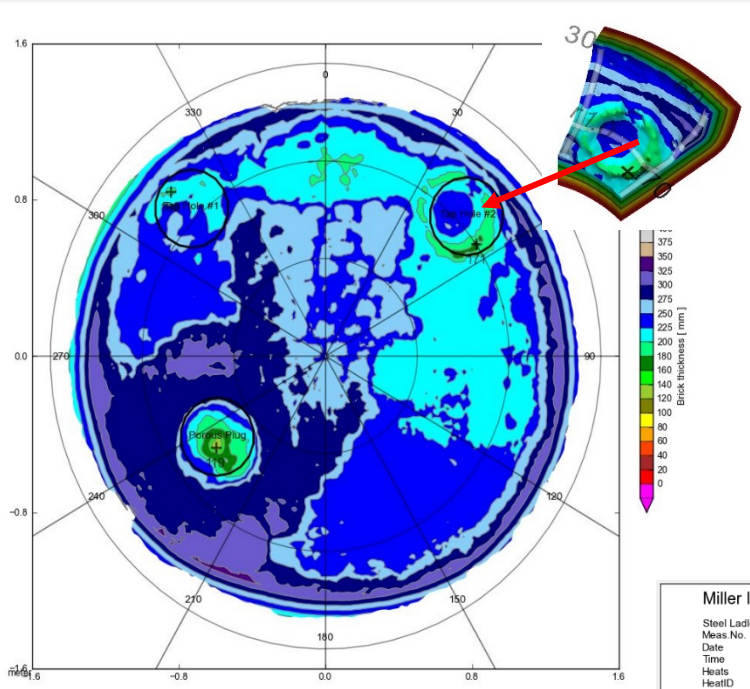


Taphole Condition and Sandfilling

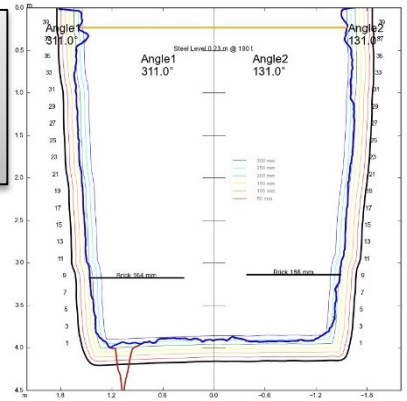


Tap Holes before sand filling

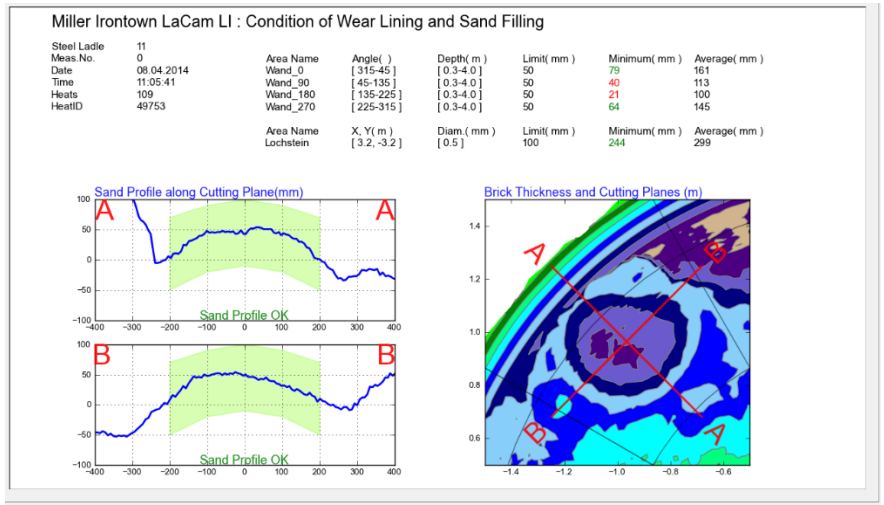




Tap Holes after sand filling



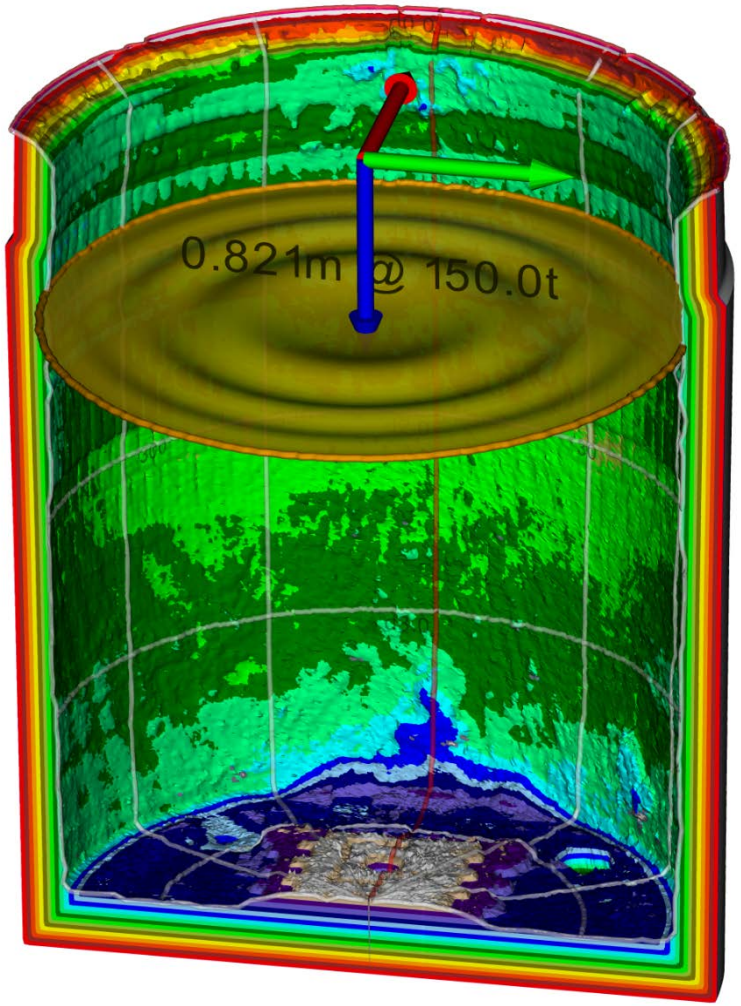
Detection of “Open slider”, Debris above slider, optimum amount of sand mass, optimum sand filling by controlled x-y-position, optimum sand profile shape

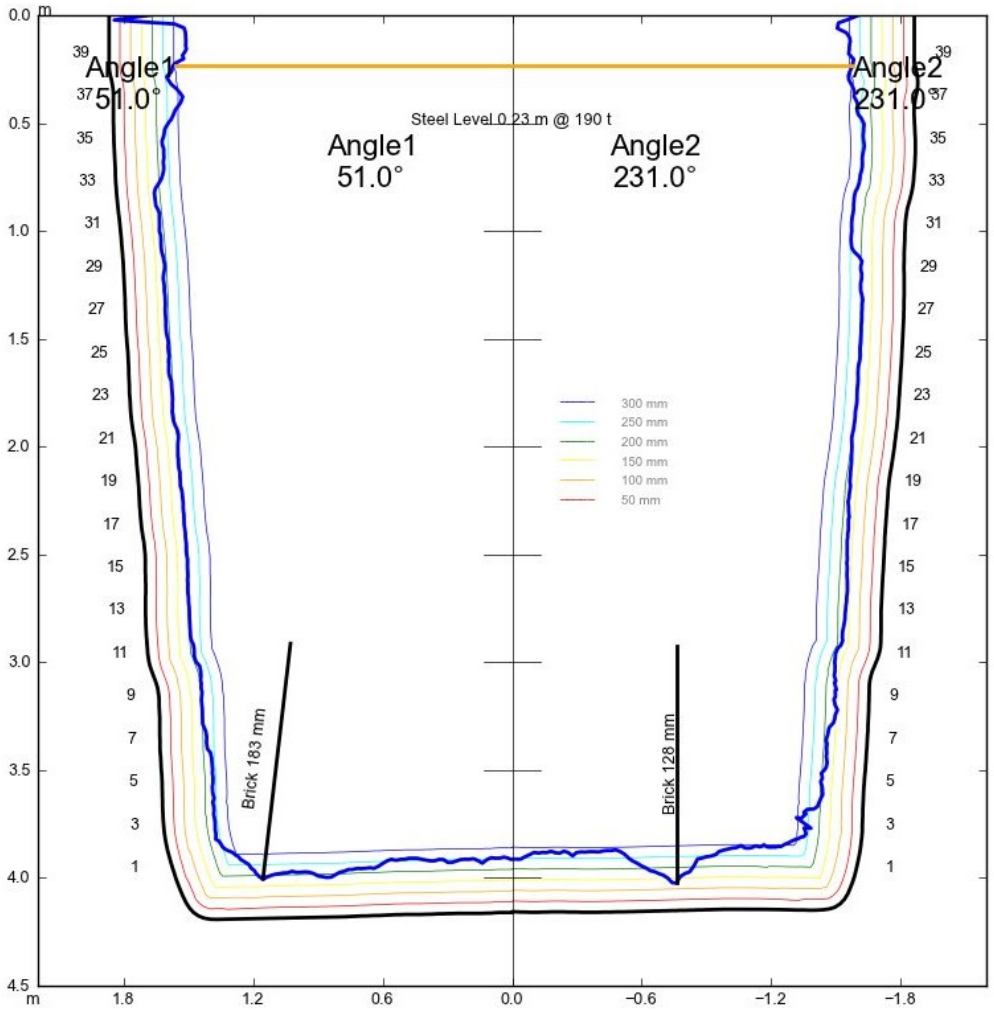


MINERALS TECHNOLOGIES MiNTEQ

FERROTRON A MiNTEQ DIVISION

Bathlevel Determination and Freeboard



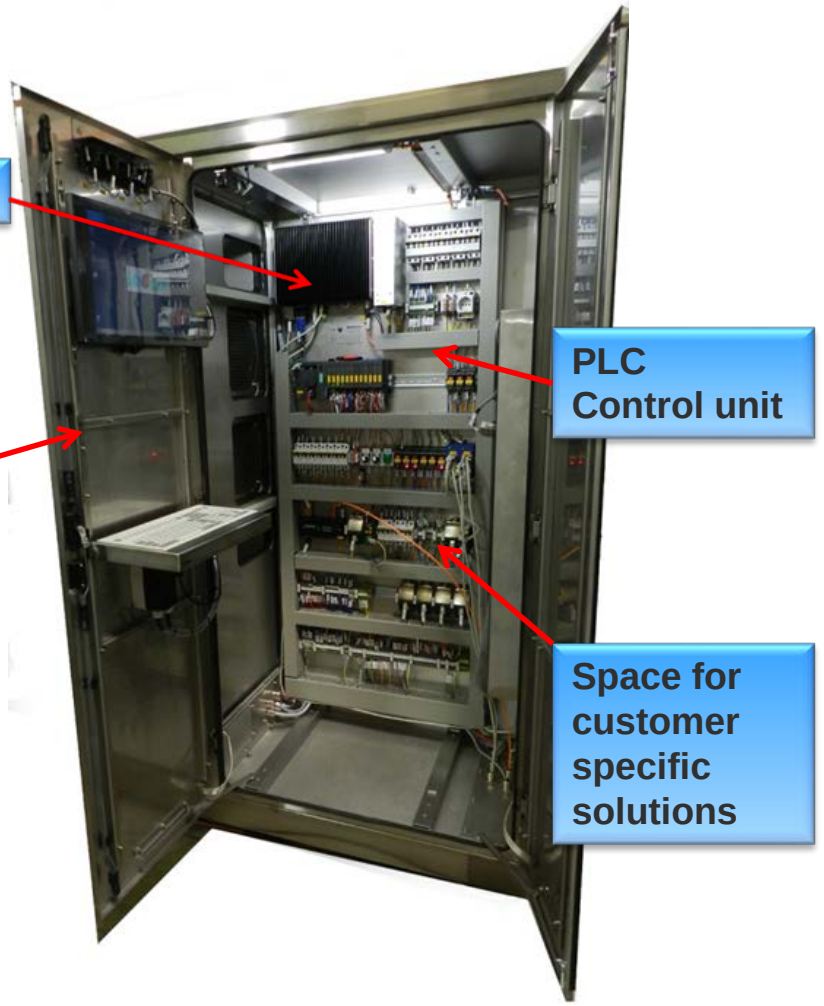


Bathlevel determination based on exact profile and volume calculation and input from steel- and slag mass

Cooling and Control Unit

IPC COMPUTER

SERVICE monitor and keyboard



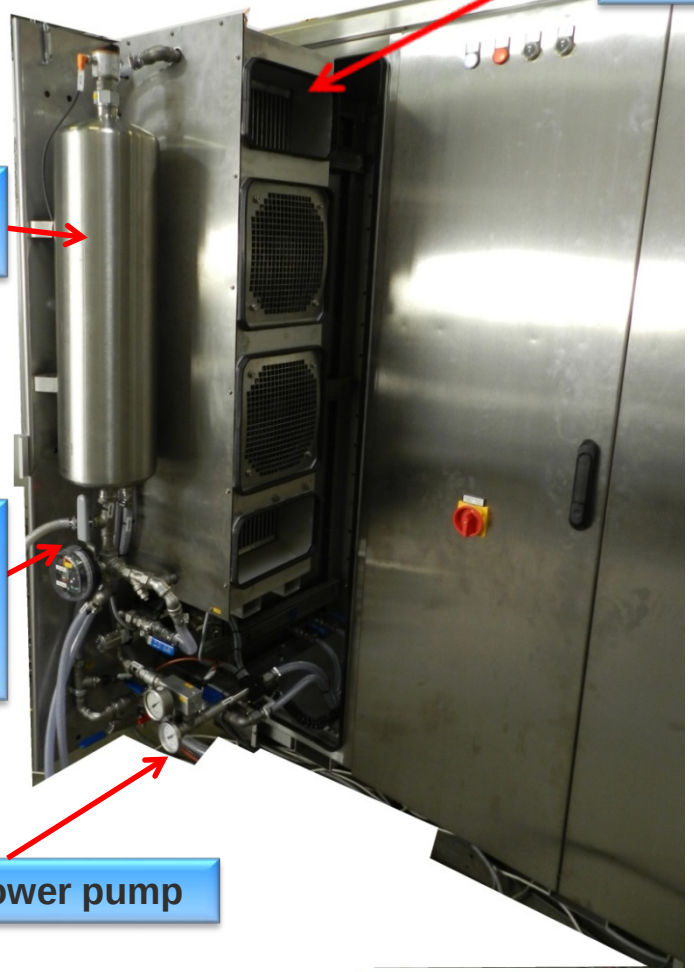
PLC Control unit

Space for customer specific solutions

Cooling and Control Unit
User friendly solution and easy to maintain

Operation mode

Service mode



Conclusion

By immersion the laserscanner into the ladle you achieve better results by means of

- Higher measurement accuracy in all areas - covering 100% of the ladle surface
- Scanning areas e.g. slagzones which are often hidden if you are using laserscanner from outside
- Very high resolution scan due to small laserbeam and better viewing angle
- Detection of gaps and cracks due to combination of thickness measurement and surface temperature
- Additional advantages like taphole analysis and controlled sandfilling
- Precise determination of bathlevel and freeboard

SCANTROL®- Intelligent Control Module between Laser Wear Measurement System LaCam® and Automatic Spraying Manipulator

LaCam® M

LaCam® CI, Converter

LaCam® - EAF

LaCam®, LI Ladles

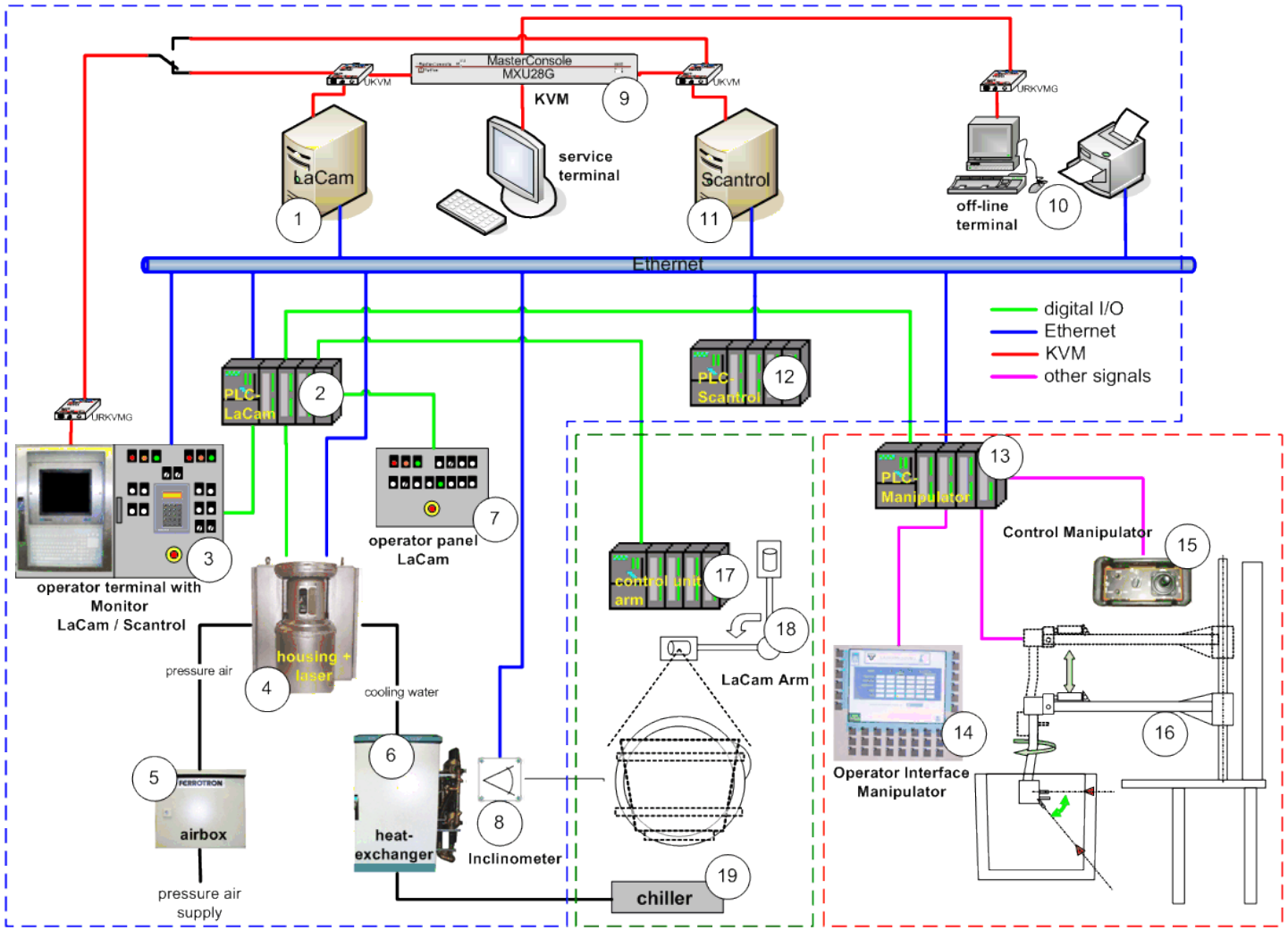
scantrol®

Tornado Shooter

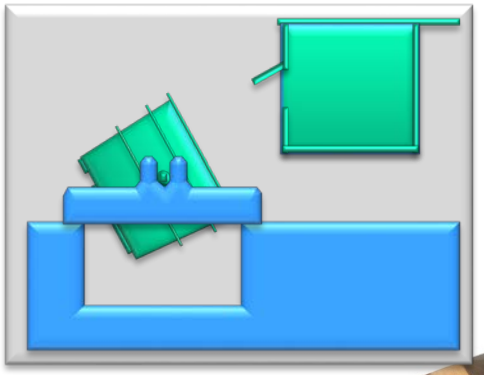
Minscan

Lego Manipulator

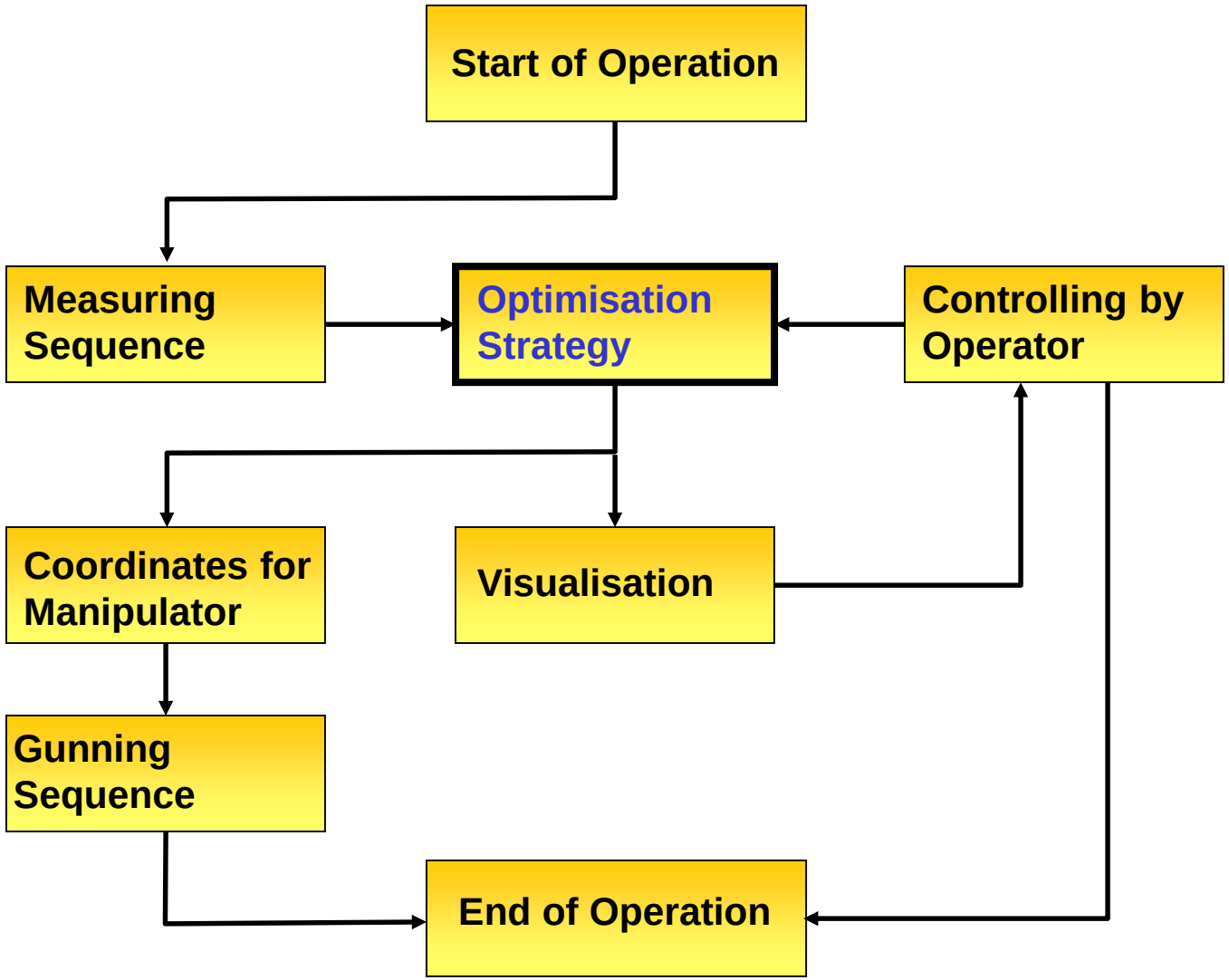
System overview Scantrol for Ladle (example)



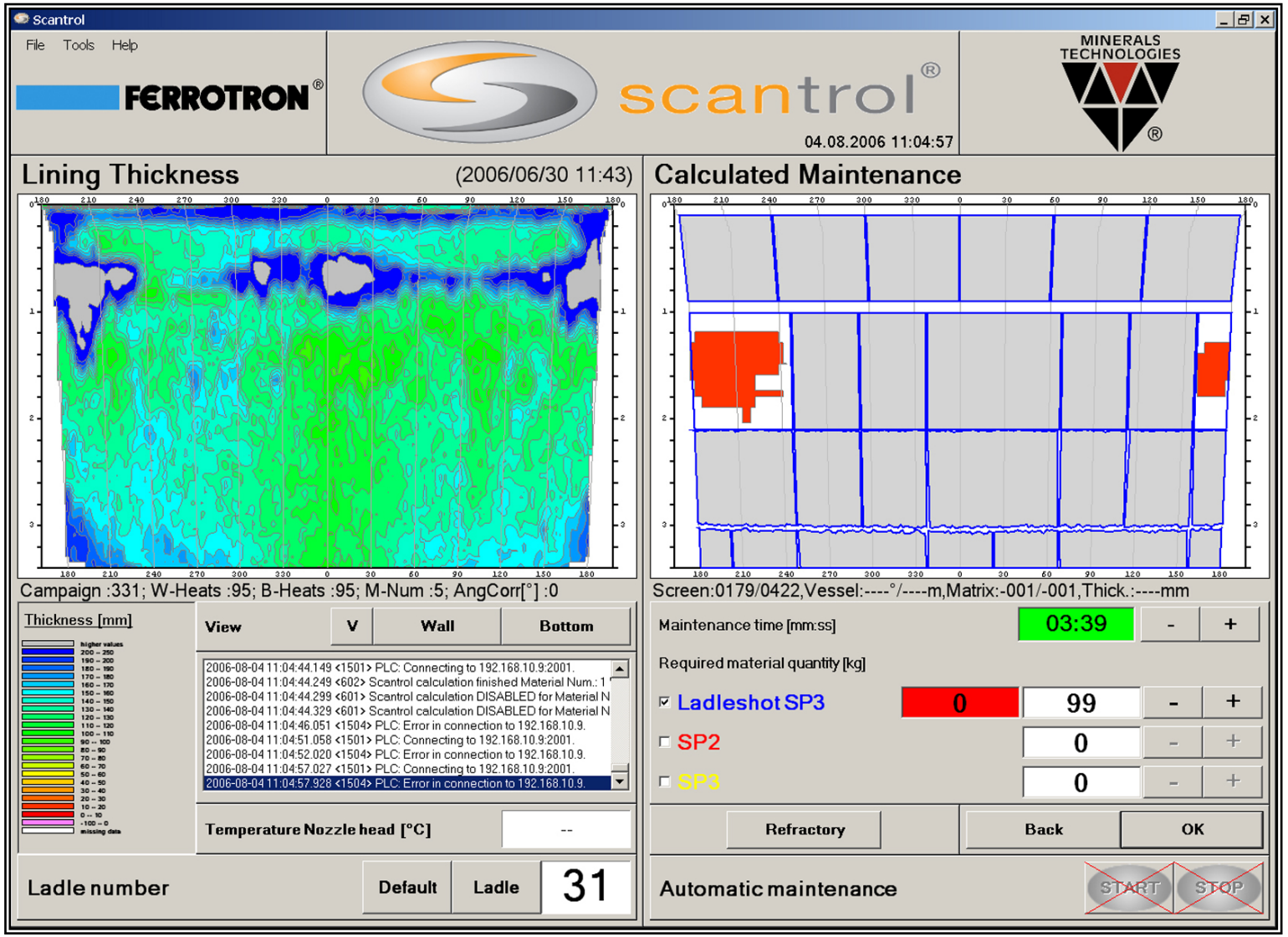
Planning in realisation of the complete system



Control Flow SCANTROL®



Scantrol® mask: Wall Areas



Controlling by Operator

- **Operator can adjust the optimisation strategy parameters**

  - gunning time (optional)

  - quantity of material

  - degree of lining rebuilding

- **Operator can decide whether to start the gunning sequence either**

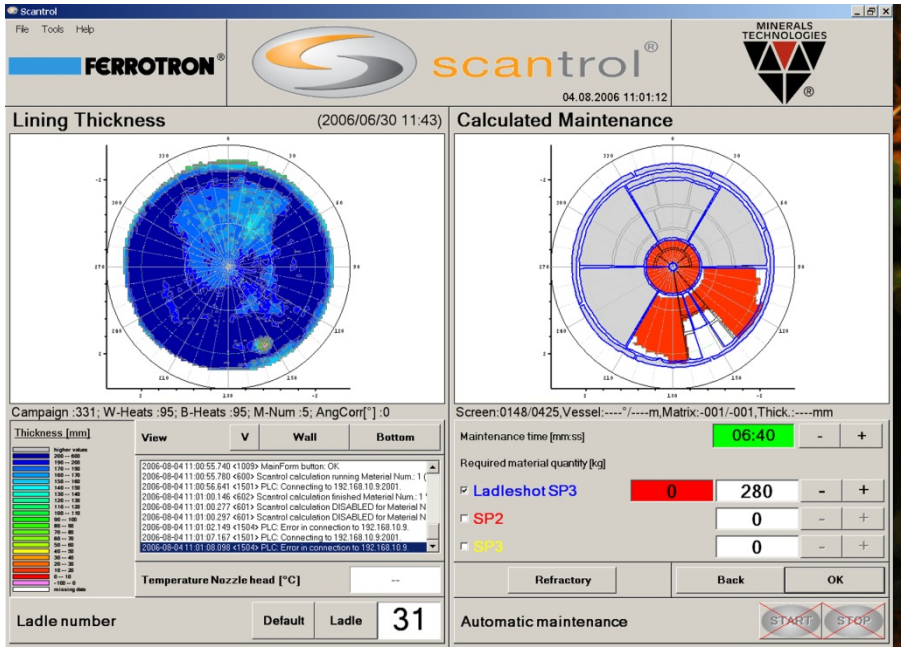
  - immediately,

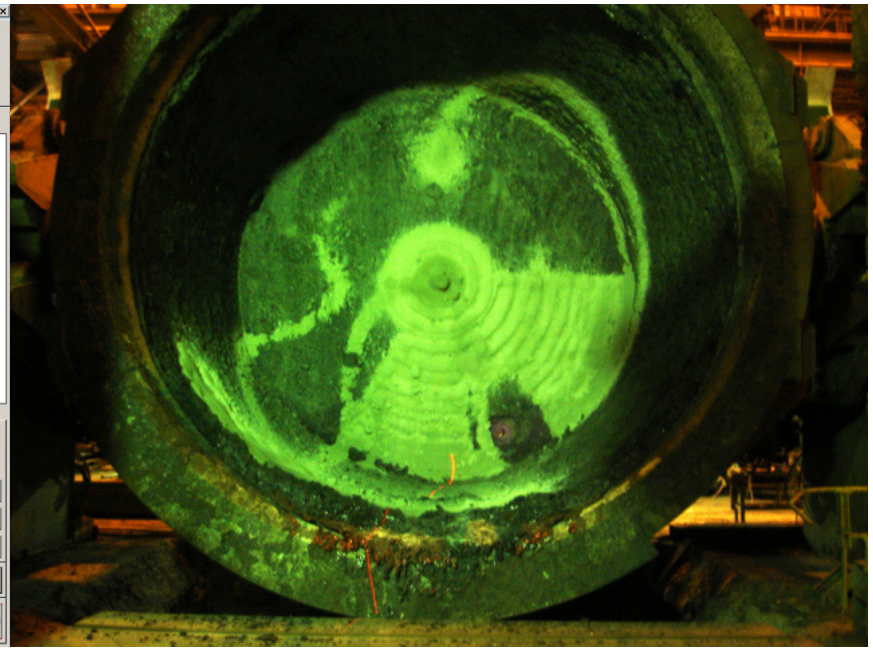
  - later on,

  - or whether to cancel the gunning sequence

Coordinates for Manipulator

The gunning areas calculated by the optimisation strategy are transformed into control commands which can be interpreted by the manipulator





Scantrol® mask: Bottom Areas

Gunning Result