smartmelter.com

+1 (703) 719.9666
info@smartmelter.com
4125 Lafayette Center Drive, Ste 200, Chantilly, VA 20151 USA

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GLASS: INSPIRING NEW FRONTIERS OF DEVELOPMENT

SmartMelter: New Industry Standard in Furnace Life Optimization

Dr. Yakup Bayram, Fred Aker, Elmer Sperry

AFGM 2019

PT paneratech

Glass: Inspiring New Frontiers of Development

- Radar Technology: Development and New Industry Standard in Furnace Health Monitoring
- Case Studies from Float, Container & Tableware
- Digitizing and Tracking Furnace Risk and Reliability

1,61km=100mm

Enablers

- O-I
- Libbey
- United States Defense Contracts
- Miniaturization
- Cloud Computing

We See Leaks Before You Do

Radar Technology for Furnace Risk Minimization

SmartMelter radar technology identifies potential furnace failure points and glass leaks 1-3 years in advance in comparison to human eye and thermal sensors.

This allows manufacturers to:

- **Safely Extend Rebuilds**
- **Avoid Costly Emergency Repairs**
- **Minimize Repair Scopes**
- **Delay overcoats**

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SmartMelter Technology

SmartMelter Technology is comprised of two key components

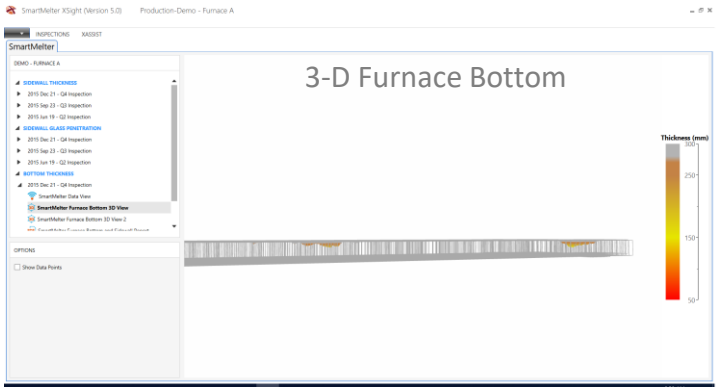
- **Easy to use advanced radar sensors with portable and permanent versions**

- **Comprehensive based software for furnace health management**

Portable Sensors

Permanently Installed Sensors

Sidewall Thickness Map



3-D Furnace Bottom

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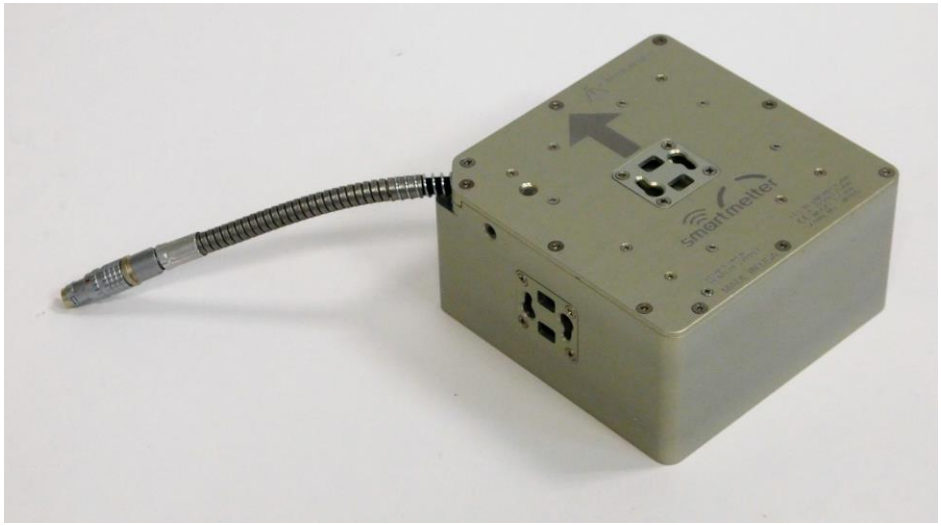
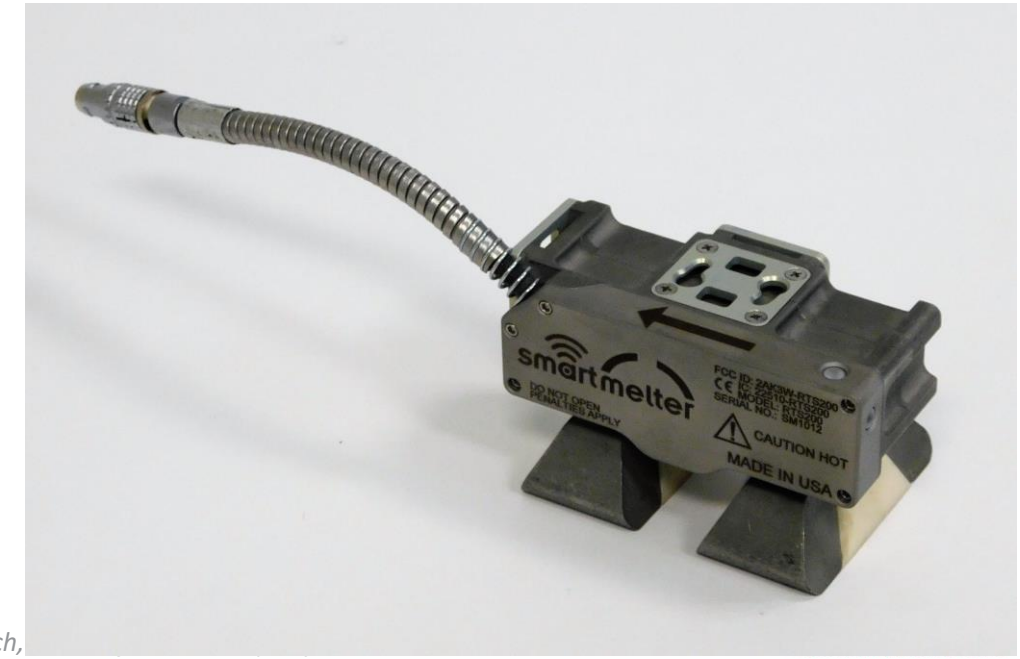
Sensor families






Panasonic FZ-E1
TOUGHPAD
10:46
YB Test May 2017
1
A
Sensors to Use
FTS 400
SELECT
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MADE IN USA

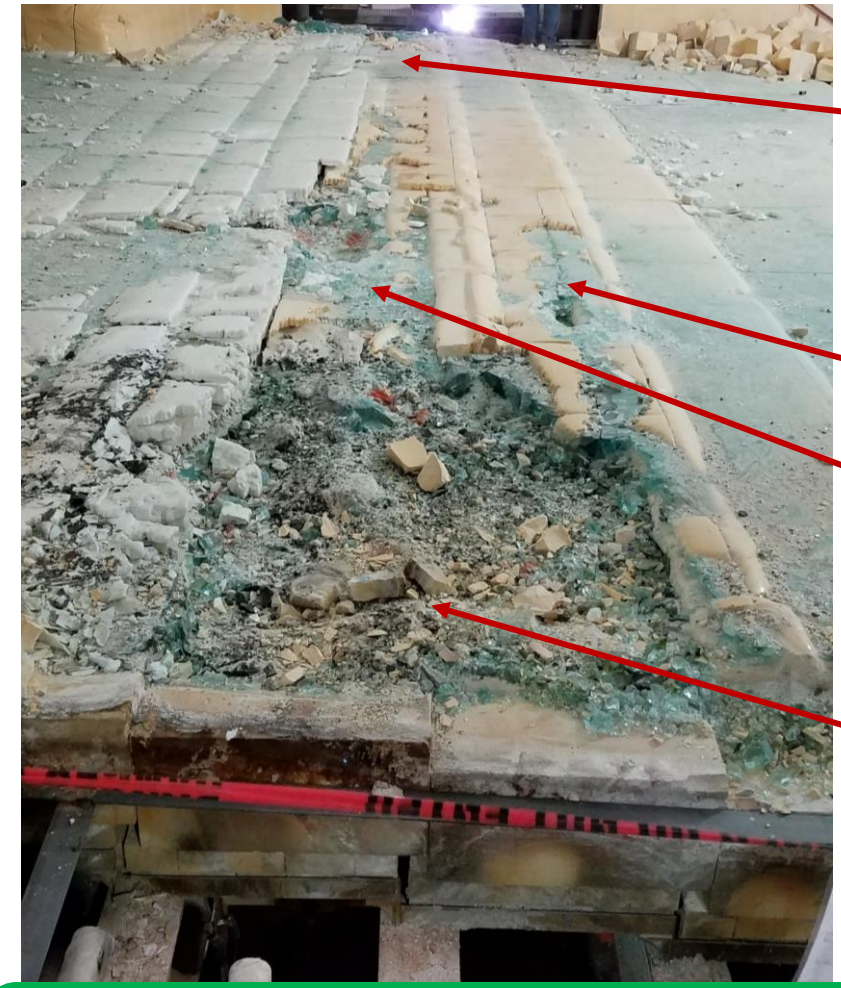
SmartMelter Technology

New Grating Sensor

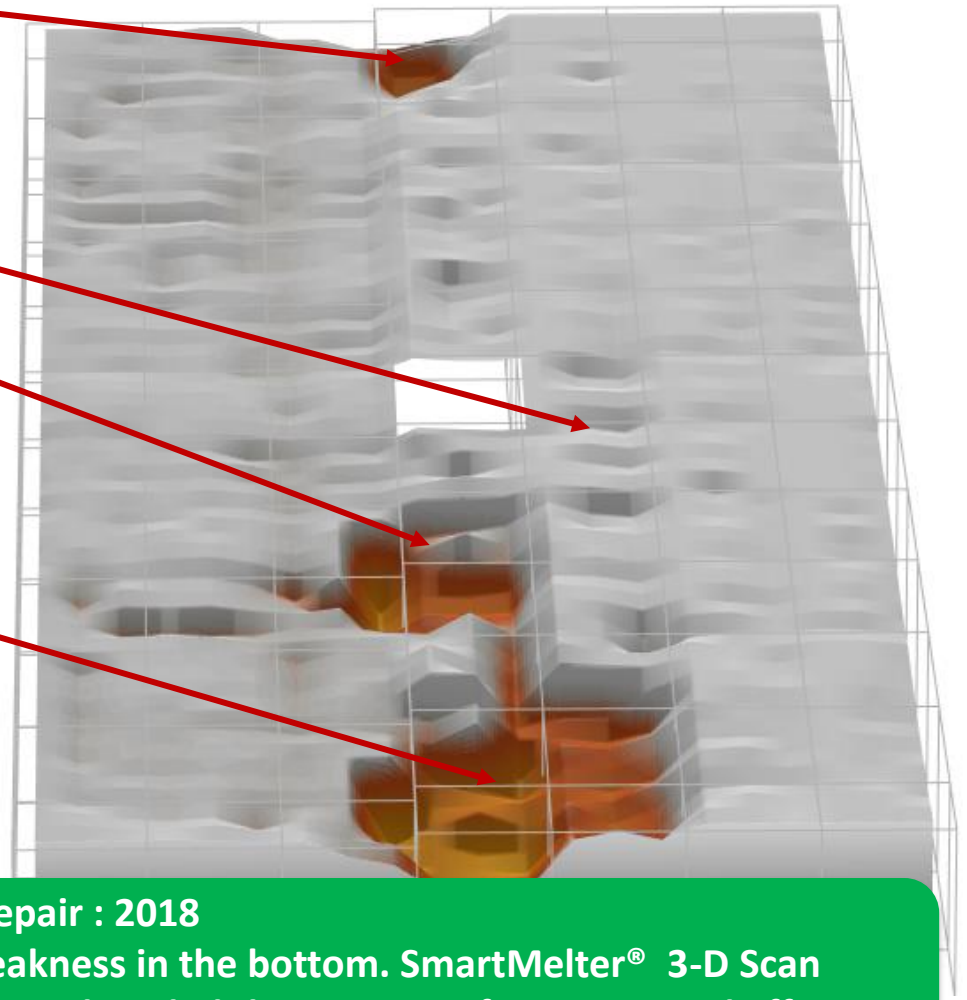
Deliverables

- Software program to visualize results
- A written report within 7 days
- A telephone/web conference after 7 days to discuss findings and next steps

Case Study 1: Float Bottom Risk Management



SmartMelter® 3-D Scan

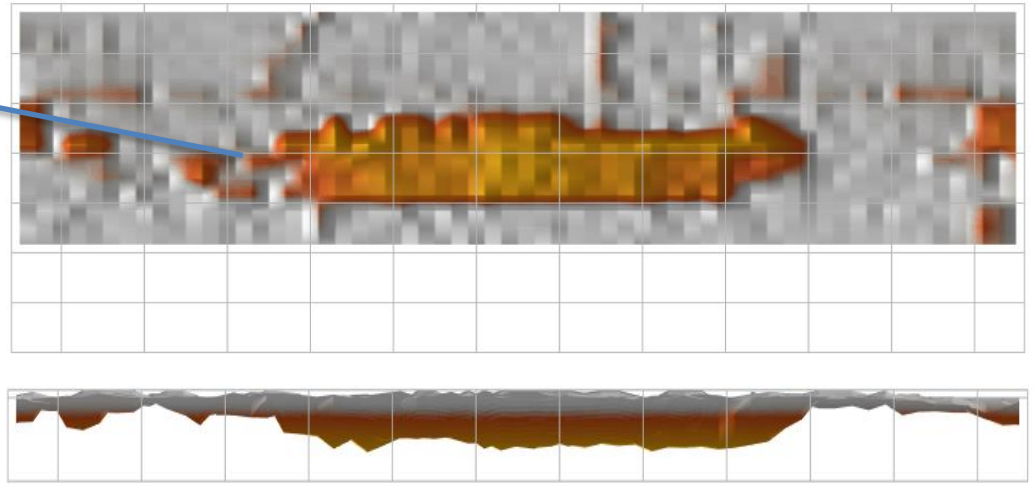


SmartMelter® Monitoring Start Year: 2016, Cold Repair : 2018
Customer engaged SmartMelter to identify any weakness in the bottom. SmartMelter® 3-D Scan indicated large glass penetration in the refiner area and guided the customer for proper and effective cooling. This furnace lasted another 2 years since our first indication of glass penetration into the bottom insulation. We monitored this furnace at least every 6 months.

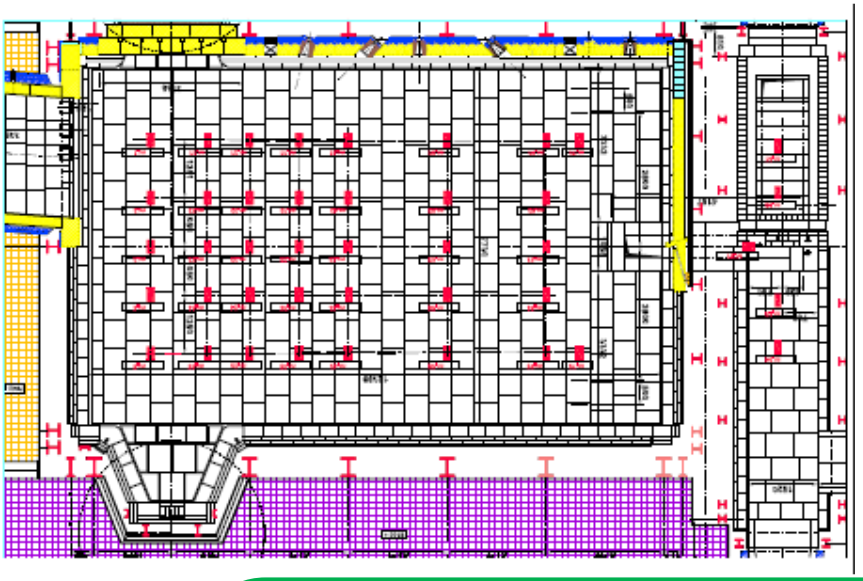
Case Study 2: Float Bottom Risk Management

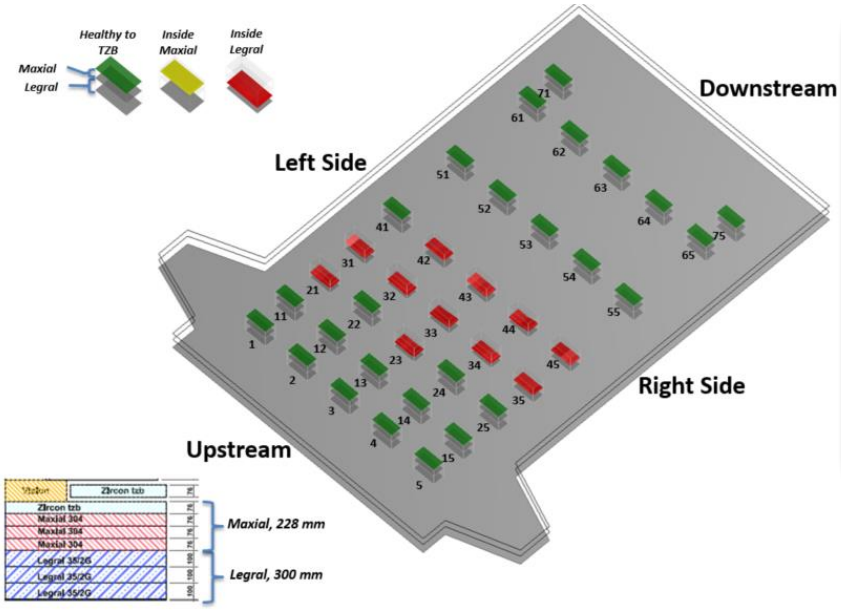
SmartMelter® Monitoring Start Year: 2017
Cold Repair : 2019
SmartMelter® 3-D Scan indicated large glass penetration with 220mm insulation left in February of 2017. We helped the customer with the proper and effective cooling. They were able to keep running the furnace two more years while the glass slowly penetrated through the insulation (Clay flux) in the bottom. We monitored this furnace at least every 6 months (sometimes 3 months) to determine the pace of erosion and assess the effectiveness of cooling

SmartMelter® 3-D Scan



Case Study 3: Container Furnace Bottom Risk Management

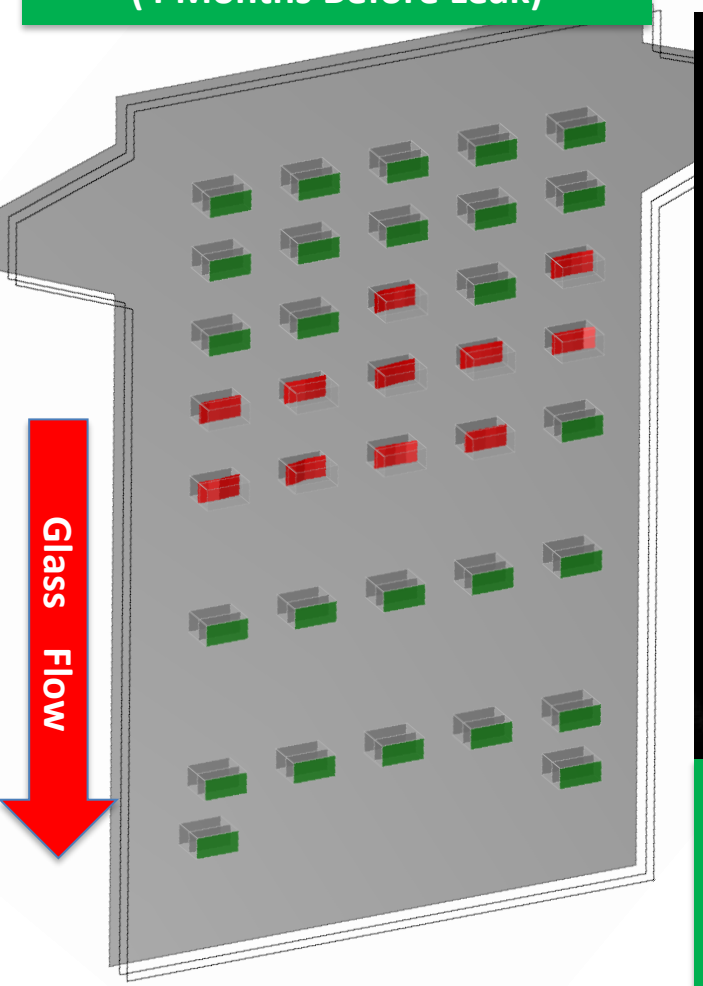




SmartMelter Inspection: August 2017
SmartMelter® 3-D Scan indicated a major glass penetration into insulation in the melter area. 130mm of light insulation was left at the time of inspection. We recommended urgent repair. The customer closed the open holes, started spraying water and scheduled the repair for 6 months later (too late!!!). The furnace leaked in 4 months confirming our report. See the next slide.

Case Study 4: SmartMelter Report vs. Reality

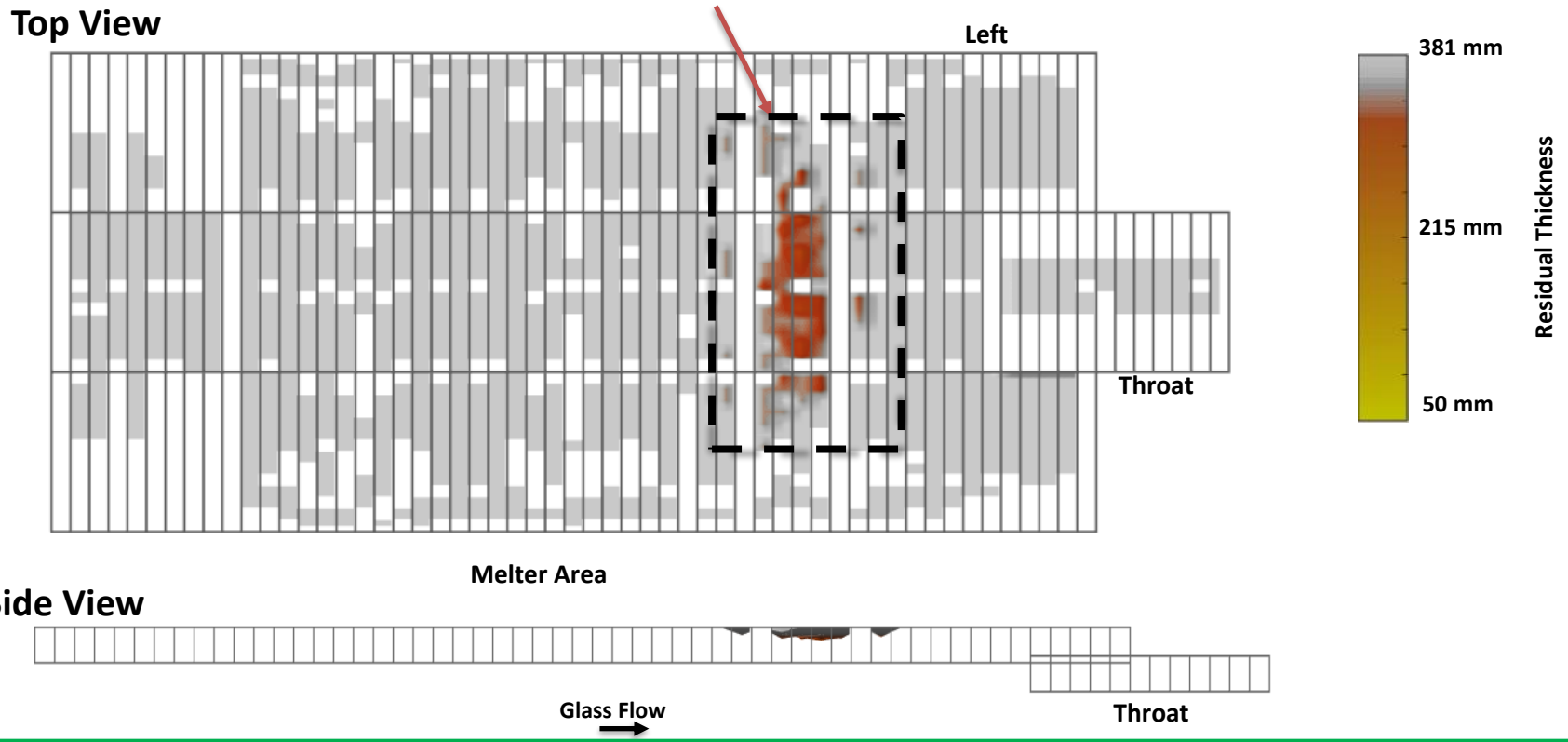
SmartMelter Inspection Map (4 Months Before Leak)



Post-Leak Photo

Post-leak photos confirmed the accuracy of the SmartMelter Inspection Report. Customer scheduled the repair too late (6 months later) despite our request for urgent action. Furnace lasted 4 months.

Case Study 5:Metal + Glass Penetration in Container Bottom



SmartMelter® 3-D Scan of this furnace bottom indicated major penetration into the bottom. Customer has been working with 3 other audit/inspection firms to do thermal and visual inspection of their furnace bottom. None has indicated any issue until SmartMelter inspection. Customer drilled several spots and confirmed both metal and glass penetration into the bottom. The customer is closely monitoring the area with regular SmartMelter inspections and in the meantime working on having a hot bottom repair done.

LIBBEY

Furnace Life Extension Story: Shreveport Furnace A

By

Elmer Sperry

Former Global Furnace Leader at Libbey Glass

Shreveport Furnace A

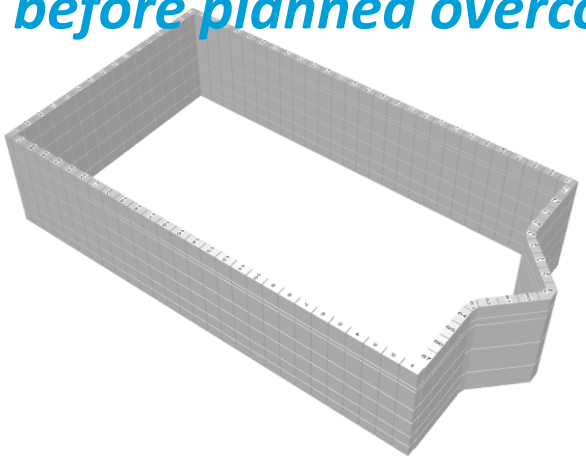
Libbey Shreveport Furnace A

- **Tableware furnace, Low iron, oxidized soda-lime glass**

Scheduled overcoat maintenance date: December 2015

- **Planned overcoat timing based on analysis of historical data, total pull, and observation of melter, pulls were higher than historical data.**

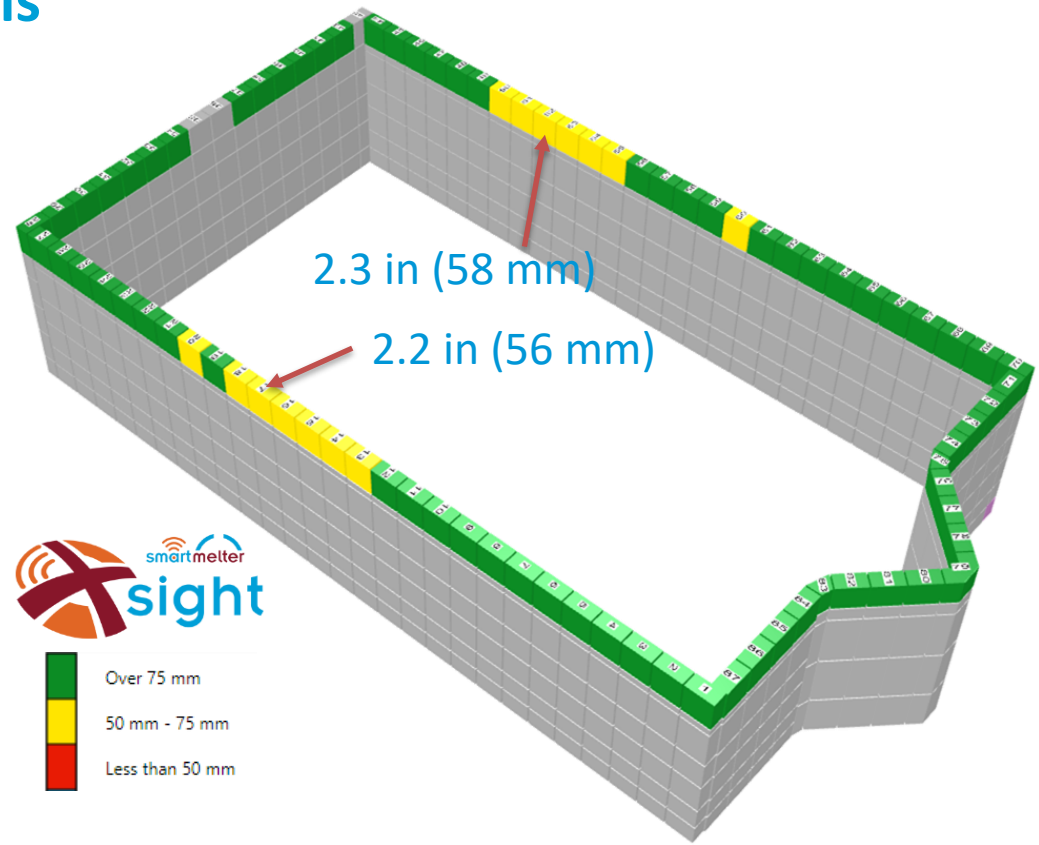
First SmartMelter® Inspection: *2 months before planned overcoat*



October 2015 SmartMelter Inspection

Oct 2015 SmartMelter® Inspection: Over 50mm remaining at metal line

Overcoat delayed given the clear picture on the current state of the melter sidewalls

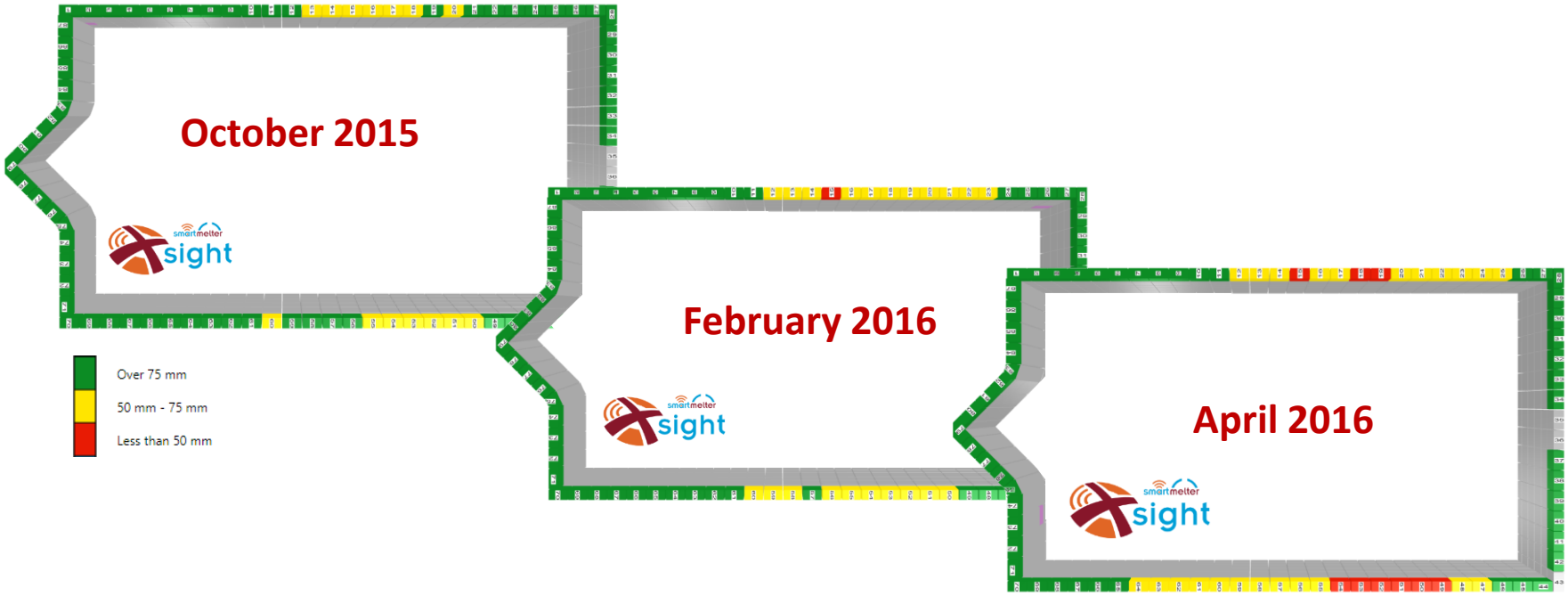


SmartMelter Inspections, 2015-2016

Overcoat operation moved to Dec 2016: One year after original plans

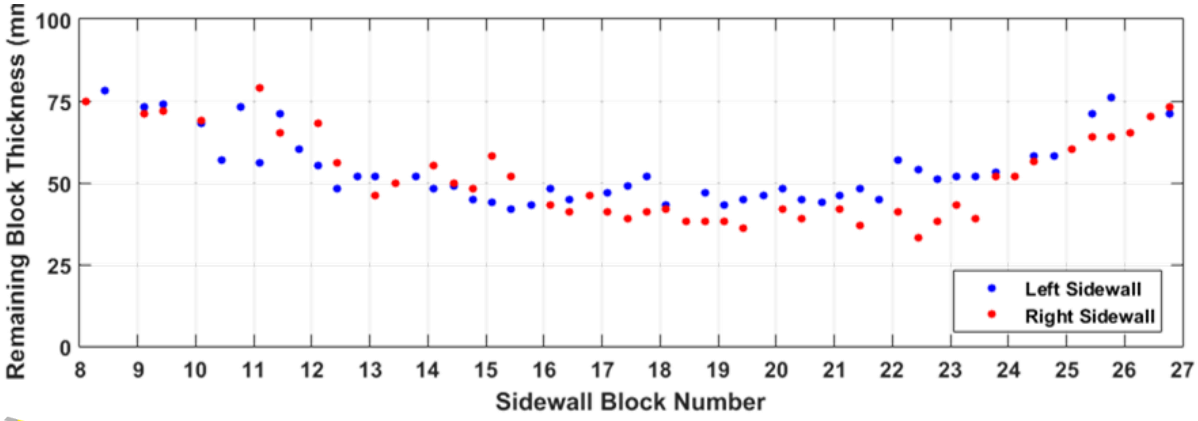
Continuous inspections of metal line thickness in 2016

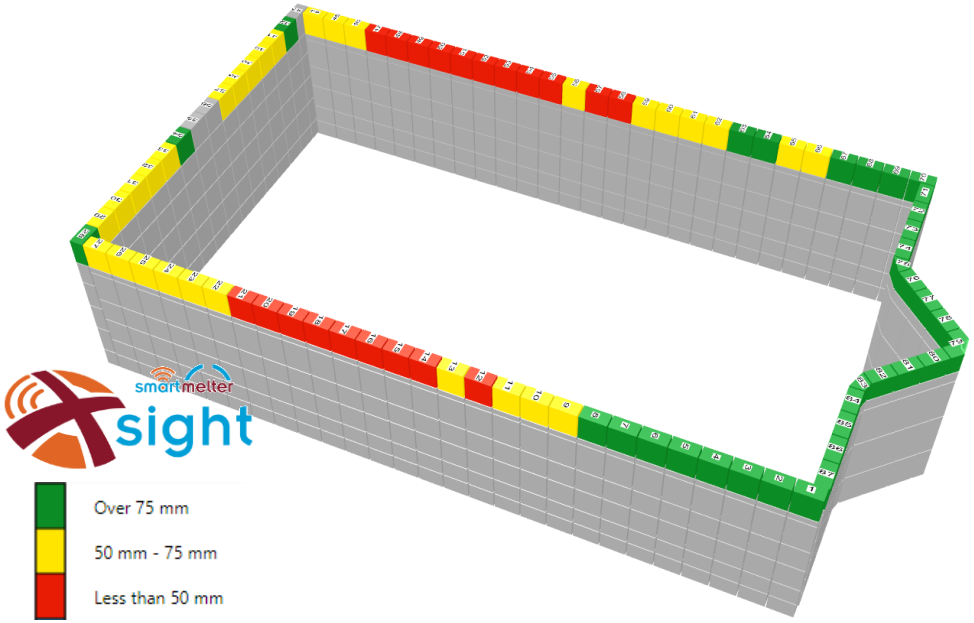
Changing furnace conditions (pull, boost) over the campaign invalidated the original historical analysis

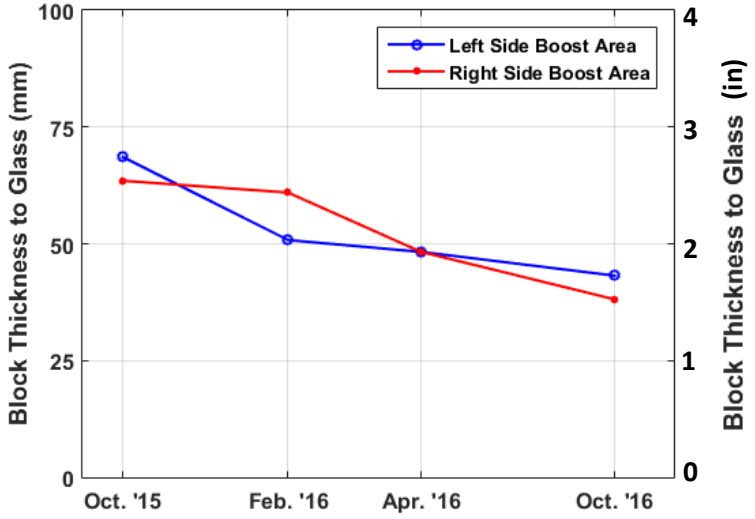


October 2016

Last SmartMelter inspection October 2016 before overcoat







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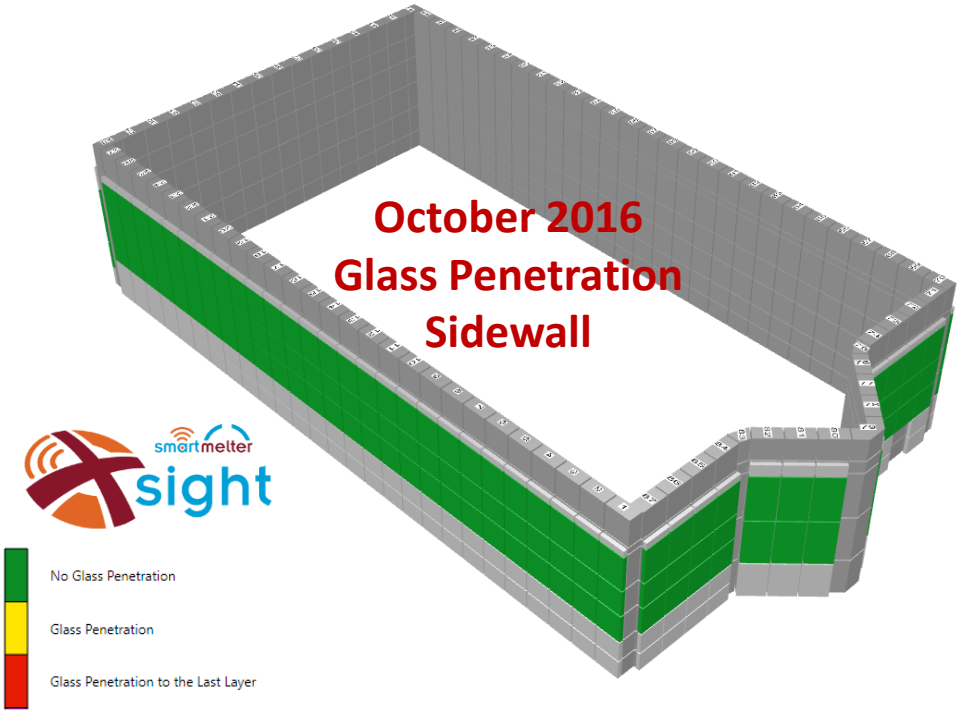
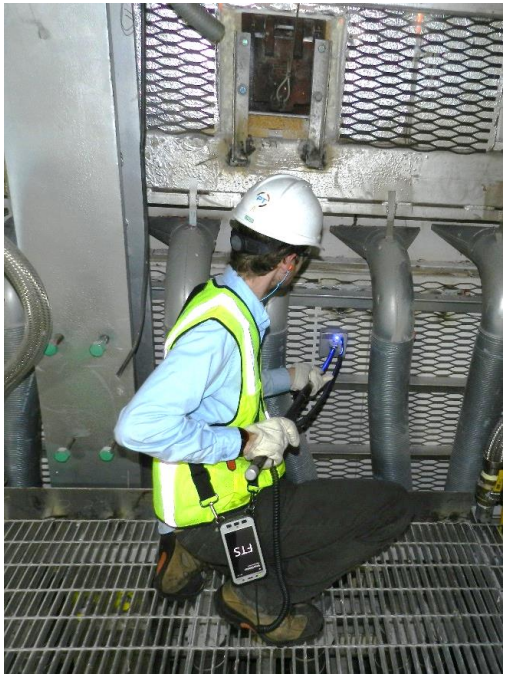
Sidewall Insulation

Beginning in October 2016, sidewall insulation for glass penetration has been monitored in addition to the metal line AZS thickness

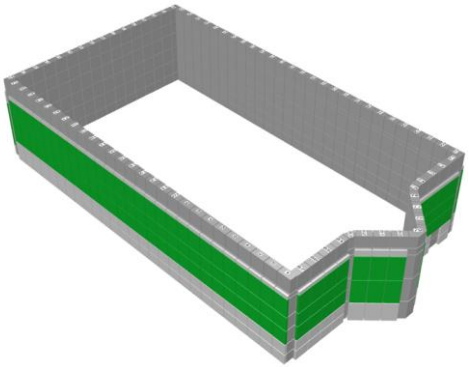
"Secure containment in the areas of the furnace that we cannot monitor accurately gives confidence to extend the repair significantly past the repair dates that are indicated by historical furnace data"



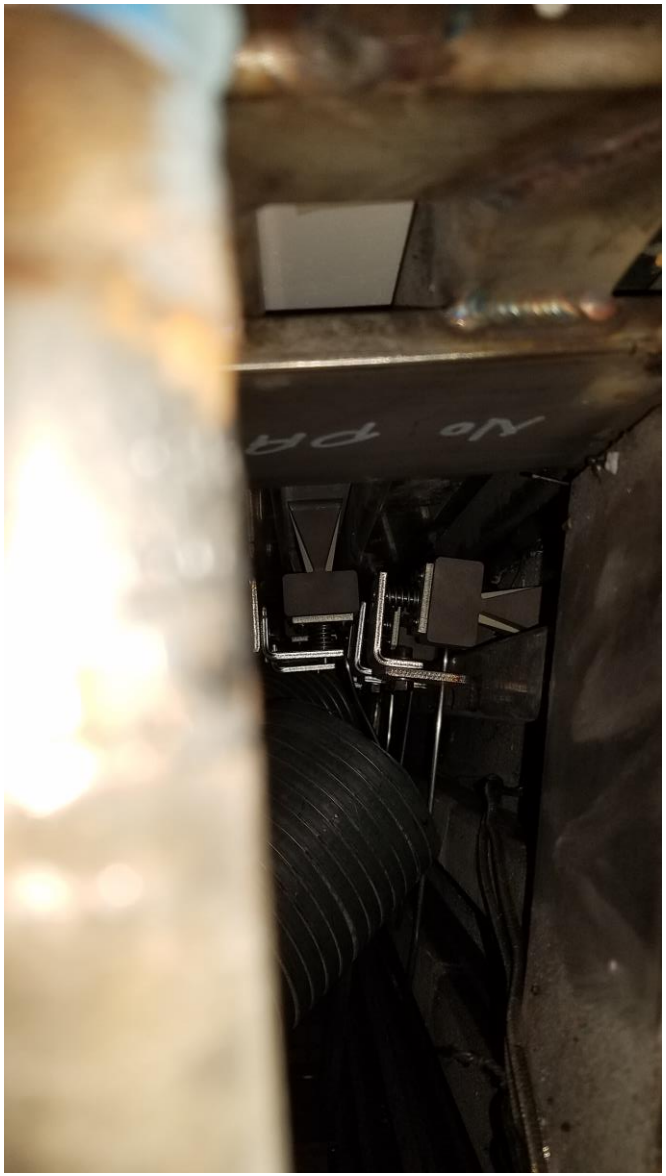


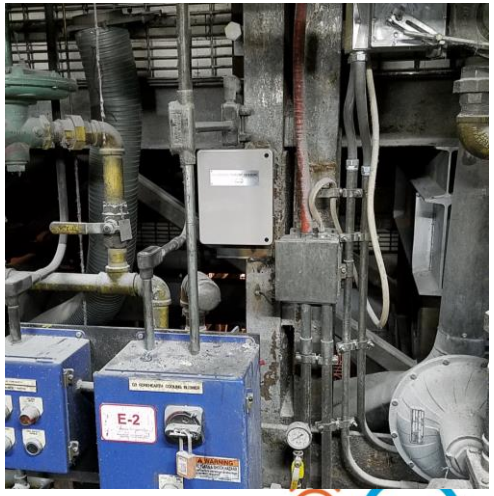
Furnace Life Extension at Libbey Shreveport A

At the end,
Overcoat Delayed 1 Year
Rebuild Delayed 1.5 Year
25% More Production than originally planned



PaneraTech IoT Sensor Pilot Program





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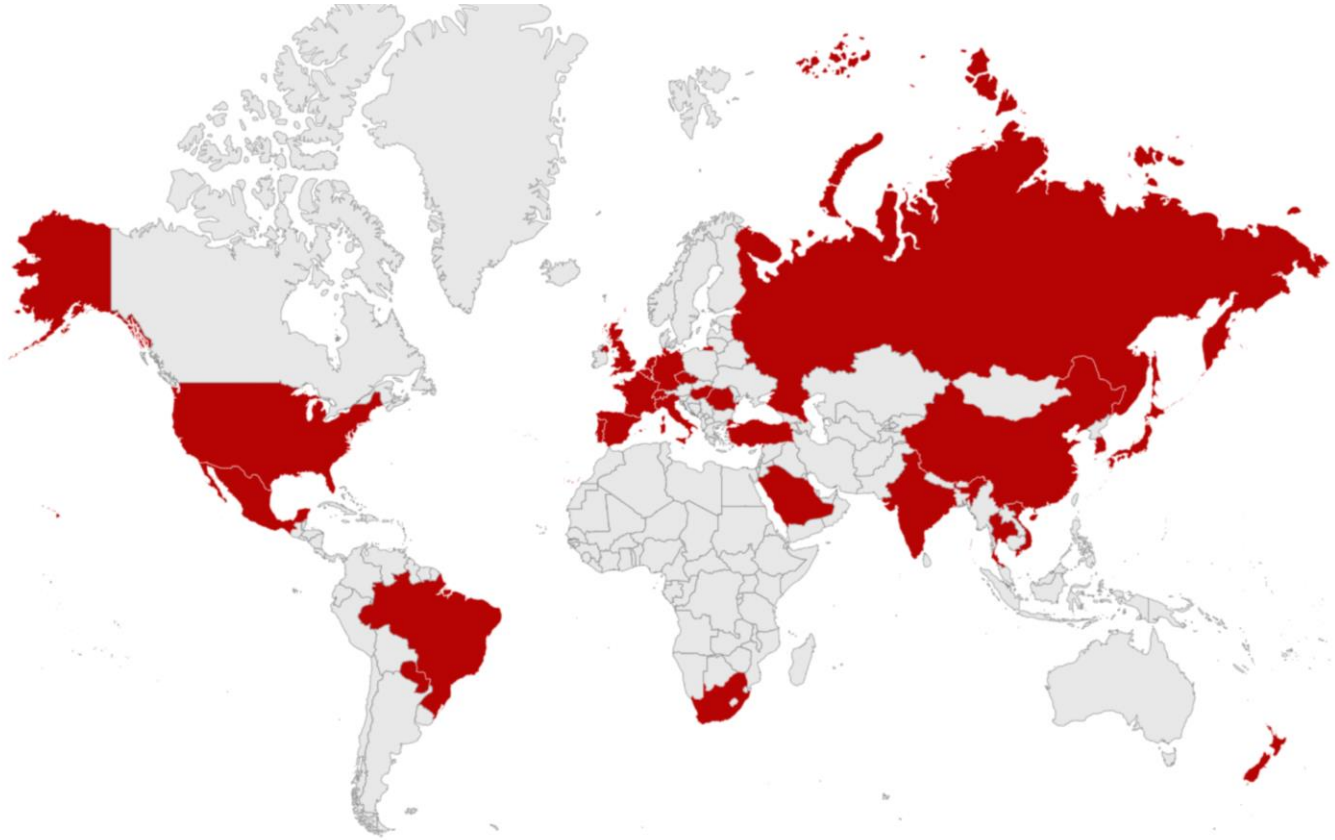
Let your insurer pay for your inspections

Global Application of SmartMelter



Since we became commercial in 2017, we have inspected more than 150 furnaces in over 40 countries

Technology Validation by Global Manufacturers

THE NEXT Frontier of Development

XSIGHT FURNACE HEALTH MANAGEMENT PLATFORM

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A Need for Digital Furnace Health Management Platform

Risk Management	• Data-driven risk and reliability assessment of furnaces
Industry 4.0 Compliance	• Standard management of furnace health in compliance with best industry digital practices
Global Visibility Across the Organization	• Full Transparency between corporate and the plants in determining the reliability and risk of furnaces
Standard Data Management with 3rd Party Vendors	• Platform is open to every vendor for performing audits and inspection: Manufacturer can work with any vendor
Spend Wisely	• Optimize maintenance budget across the asset portfolio

SmartMelter XSight: Furnace Health Management Platform

SmartMelter XSight offers data-driven health management platform for furnace risk tracking and assessment.

- Single platform to integrate all health audits/inspections
- Quantifies and tracks risk and reliability of the furnaces
- Improved maintenance planning and tracking
- Data-driven furnace risk analysis

How we are offering it?

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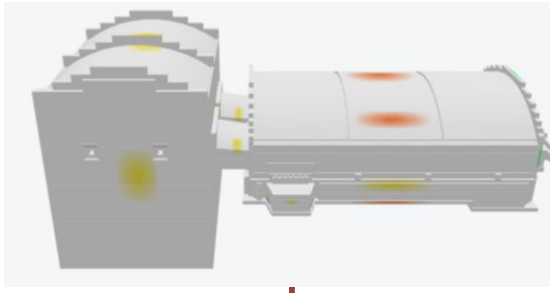
SmartMelter Hosted Amazon Cloud Platform

Manufacturer Hosted Private Cloud/Server

Private Cloud

XSight Information Flow Diagram



Furnace Physical Model

Crown
Bottom
Sidewall
Regenerator Crown
etc.

Furnace Operational Parameters

Melter Temperature
Cullet Ratio
Glass Type
Pull Rate
Cumulative Pull
Glass Color
Boosting Capacity Usage
Bubbler
etc.

MAINTENANCE

OBSERVATIONS (ISSUES)
Risk Level
Link to a dataset
Description
Recommended action
Maintenance

Datasets (Inspections)
Visual Photos
Endoscopy Photos
Thermal Photos
1-D, 2-D, 3-D Data

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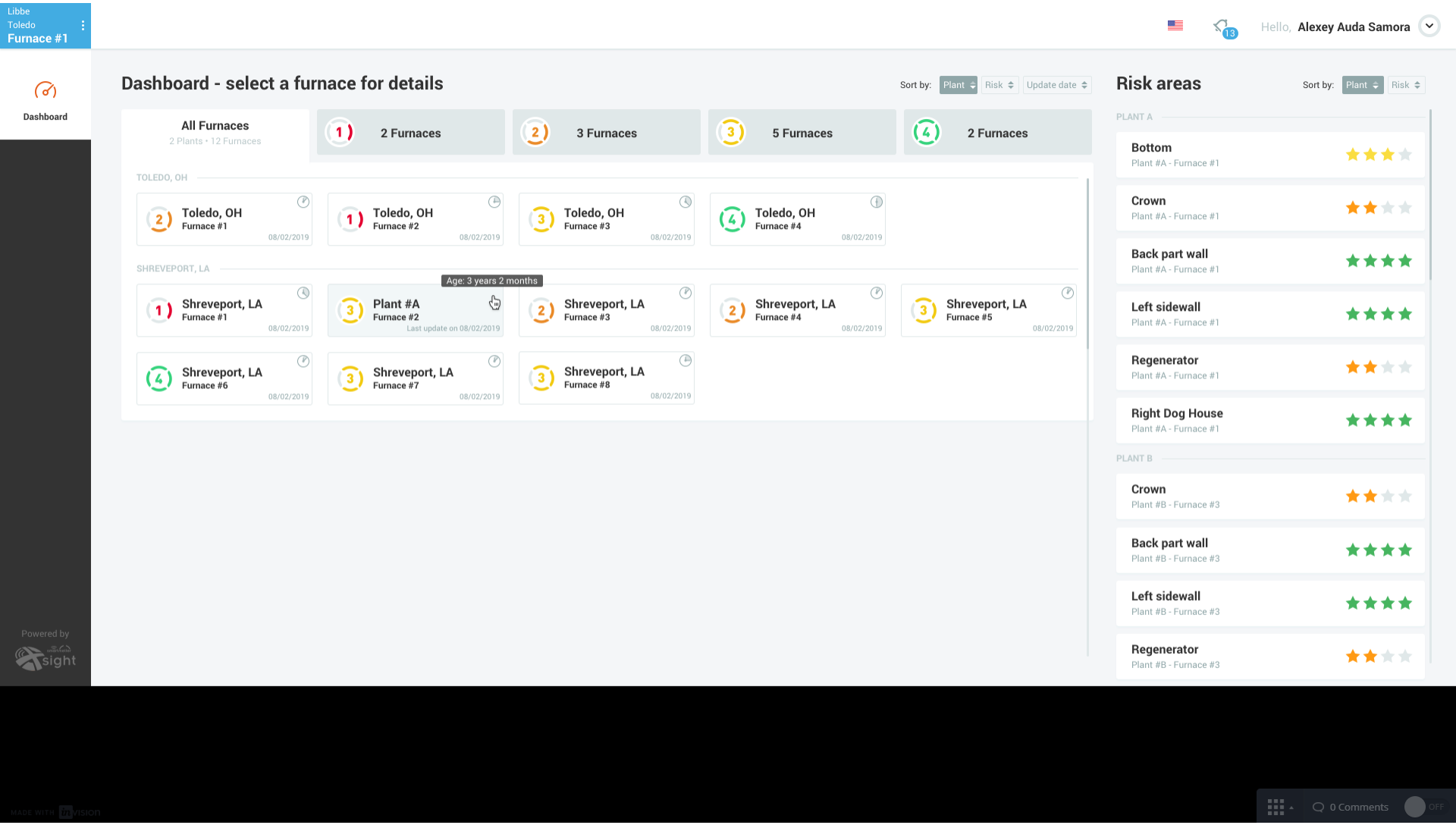
Dashboard for Global Furnace Visibility



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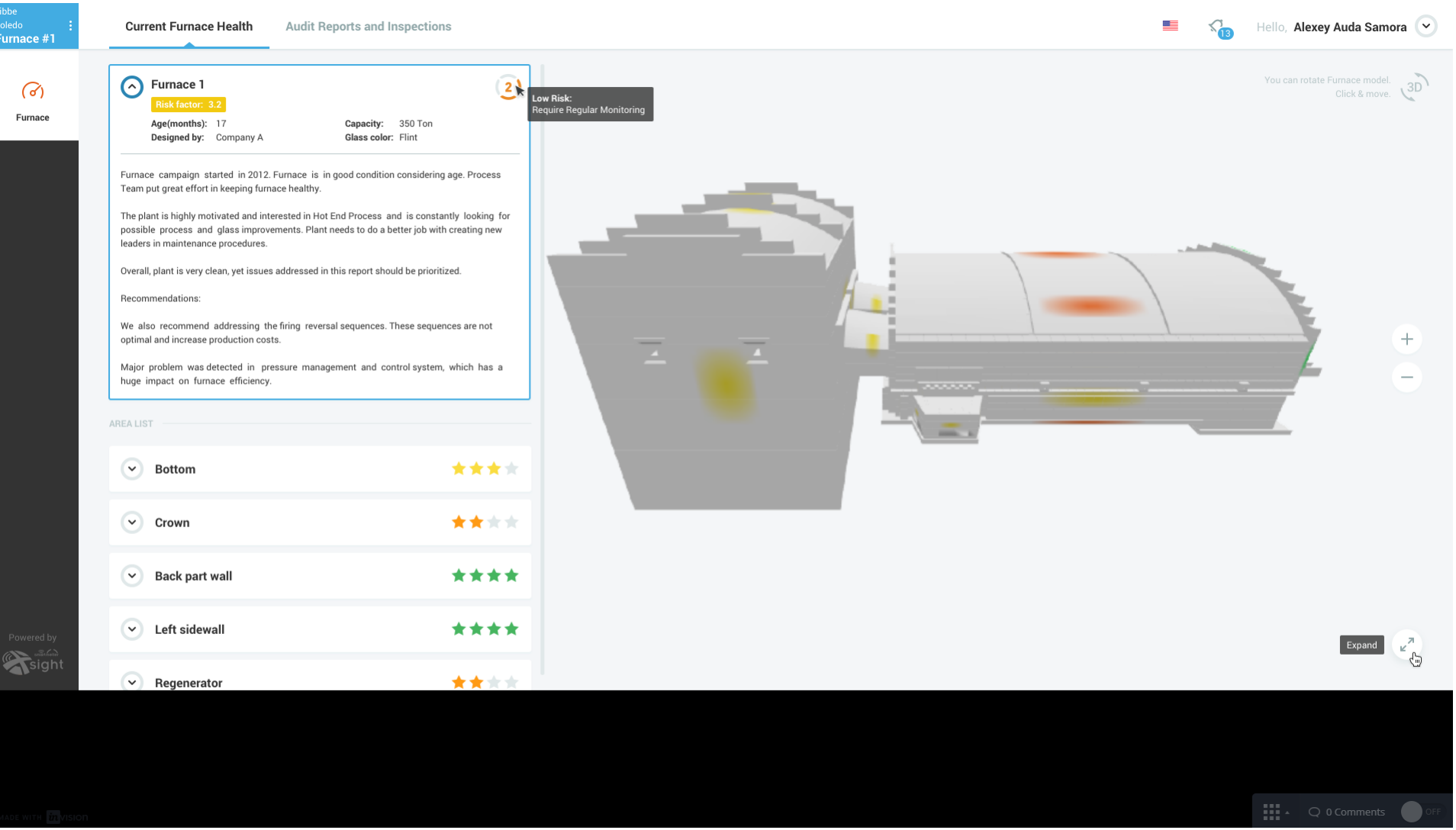
Furnace Health View



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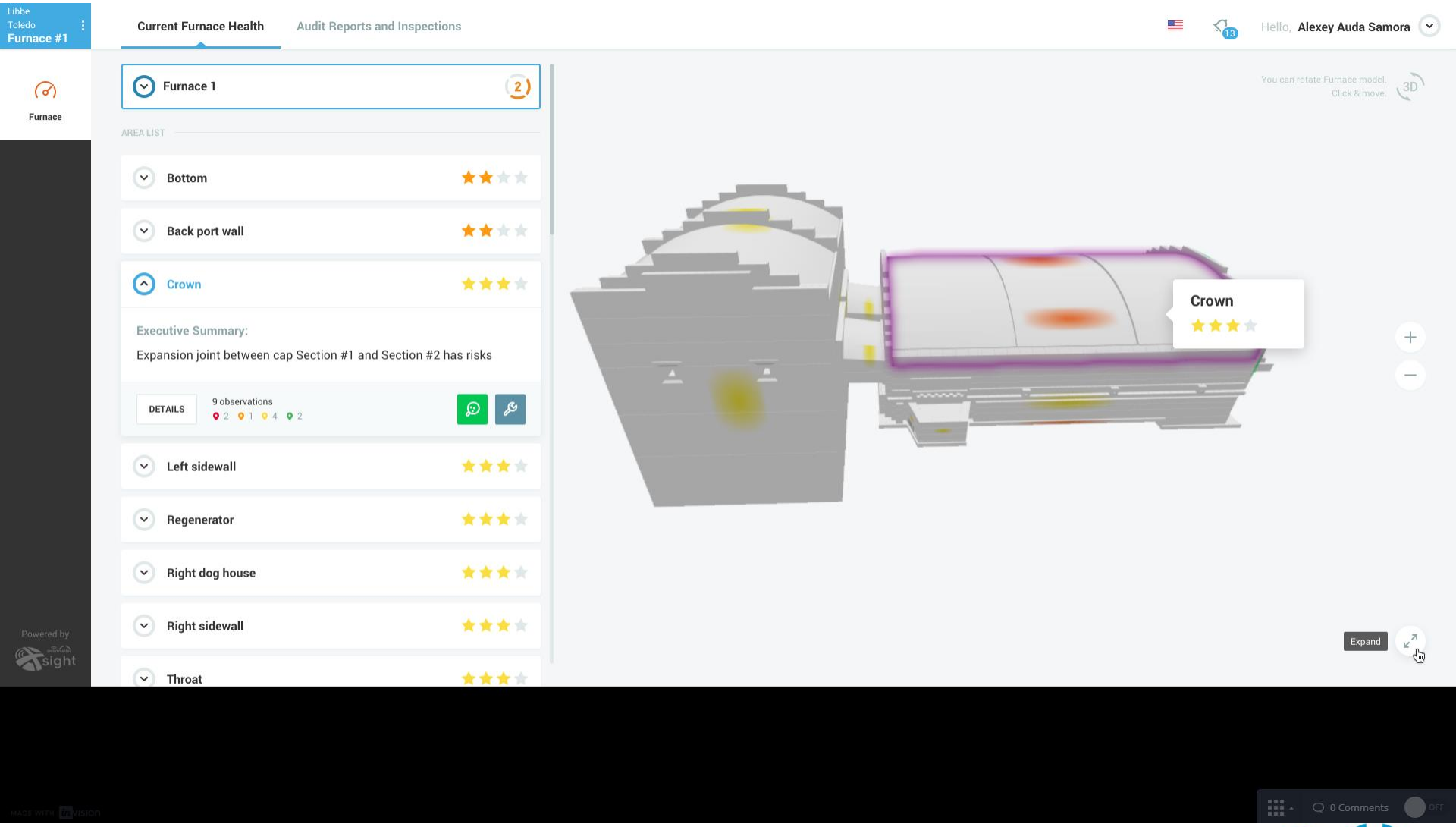
Furnace Health View



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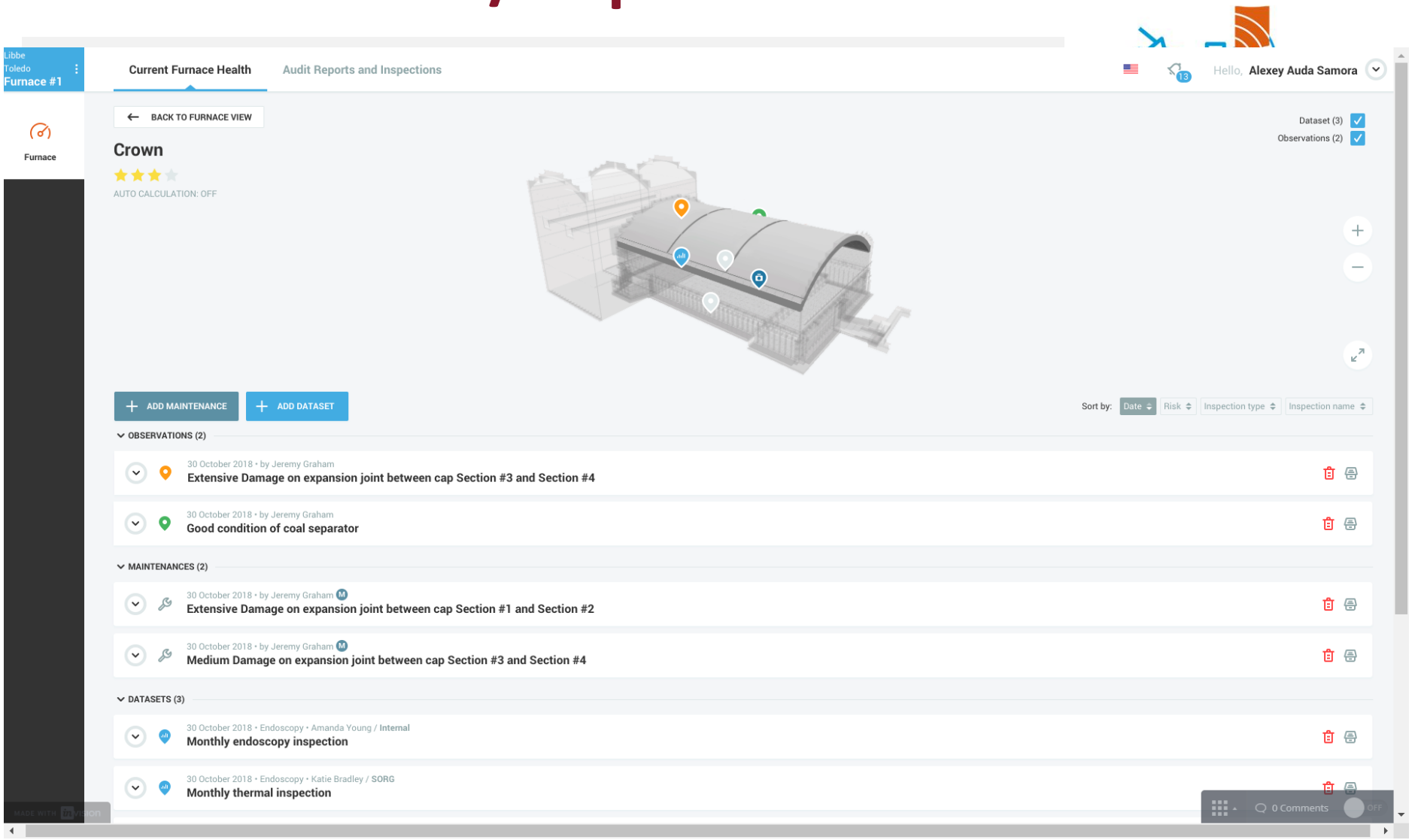
Audit/Inspection Module



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Xsight Furnace Health Platform

- In pilot phase with select customers Q4 2019
- Can be the topic of a future AFGM presentation

Thank You!

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