INTELLIGENT PHOTON DELIVERY SYSTEMS POWERED BY IoT

RadTech USA, May 2018, Mike Gharagozloo
AGENDA

1. BACKGROUND OVERVIEW
2. LIGHT HAMMER MKIII POWER SUPPLY INTELLIGENT IRRADIATOR
3. AIMS IoT
4. AIMS CLOUD AIMS CLOUD PREDICTIVE
BACKGROUND - MICROWAVE (MW) POWERED UV SYSTEMS

- Until now,…
  - only power supply parameters were measured/reported
  - no irradiator parameters were measured/reported
    (photodetector & air pressure switch were considered interlocks)

- Further building upon our latest, most technologically advanced MW powered system, the **LightHammer® 10 Mark II**, a number of sensors have been integrated into the irradiator to make the **Intelligent Irradiator**.

- These new irradiator parameters can then be provided to our optional **Advanced Integrated Monitoring System (AIMS)**.
  - for enhanced system diagnostic, preventative maintenance, predictive analytics, and much, much more…
Starting with the LightHammer Mark II power supply as the foundation

PLUS the new Intelligent Irradiator

To enable…

LOWER COST OF OWNERSHIP

Heraeus Noblelight’s new LightHammer Mark III is now here to provide reliable UV technologies for efficient processes.
BENEFITS - LIGHTHAMMER MARK III POWER SUPPLY

- **Lower Cost of Ownership**
  - 20+% Energy Savings compared to legacy MW powered systems
  - ~99% Power Factor Correction (PFC) under full load
  - Higher reliability
  - Minimum Total Harmonic Distortion (THD)
  - 100% Balanced 3-Phase Power Loading

- **Scalable, modular system**

- **Utilizing today’s latest state-of-the-art power electronics technology**
  - Up to 75% Lighter than ferro-resonant power supplies

- **DC output with essentially no output ripple**

- **Universal Industrial Input Power, auto ranging 200 - 480VAC, 50/60Hz**

- **Standard Industrial Communication Protocols**
  - DeviceNet™, ProfiBus®, ProfiNet®, EtherNet/IP™
  - Dry Contact (standard)

- **IoT Enabled**

- **Optional solid-state blower power module integrated into power supply**

- **Backward compatible with legacy Light Hammer & LightHammer Mark II power supplies**

- **Green Technology (RoHS)**
THE INTELLIGENT IRRADIATOR

Front View

- Magnetron Temp Sensors
- UV Sensor Enables relative UV measurements
- Thermopile Enables bulb temperature measurements
- Analog Air Pressure sensor Enables variable cooling function

Back View

- Inlet Air Temp/Humidity Sensor
- Main Module

Includes:
- Orientation Sensor
- Analog Air Pressure Sensor
- Temp Sensor

All new sensor boards designed, tested & qualified for:
- RF interference
- UV exposure
- Internal operational environment

The Internal UV sensor does not replace external radiometry
SMART UV SYSTEM

LightHammer Mark III System with AIMS

Intelligent Irradiator

LH10 MKIII Power Supply

AIMS

Communication Cable

AIMS Network

Intelligence Inside

MKIII Power Supply:
- Switch-Modes Solid-State Technology
- AIMS Enabled
- Advanced Field Bus Enabled
- Power Factor Correction of > 99%
- High Efficiency (~94%)
- Green Technology
- Lower Cost of Ownership
- Modular Design Concept
- Auto Input Voltage Ranging (3-phase)

UV sensor
Bulb Temp sensor
Mag A Temp sensor
Mag B Temp Sensor
Inlet Air Temp Sensor

Main Board
- Orientation Sensor
- Analog Pressure Sensor
- Ambient Temp Sensor
- Humidity Sensor

I²C

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PARAMETER DATA - INTELLIGENT IRRADIATOR

Measurement Data

- UV Intensity & Bulb Temperature
- Temperature & Humidity
WHAT IS AIMS?...**Advanced Integrated Monitoring System**

› AIMS software application in conjunction with hardware (dongle) is used to monitor the system parameters during real-time operation.
› Capable of monitoring up to 30 Light Hammer Systems.

AIMS: Advanced Integrated Monitoring System

LightHammer Mark II or Mark III System

Dongle

AIMS: Advanced Integrated Monitoring System
AIMS: INTEGRATION & REAL-TIME PERFORMANCE MONITORING

* LH Mark II shown for illustrative purposes only; LH Mark III would be the same.
AIMS – FEATURES & BENEFITS

- Improves system uptime and maintenance.

- Displays & Monitors performance parameters of *LightHammer Mark II & Mark III Systems*.
  - Minimizes unscheduled system shut down
  - Central location to collect, display and email all critical system information/data.
  - Displays a high level status of all *LightHammer Mark II’s* or *Mark III’s* connected.
  - Monitors system parameters and sends email notification when critical predefined thresholds are reached.
  - Sends e-mail notification (when configured) when a warning/fault is detected or set control limits are exceeded.
  - Automatically creates a data file for each day of operation.
  - Emails periodic system summary report for all connected units when configured.
  - On Board “hour meters tool” to track the maintenance schedule of key consumables (magnetrons, bulbs, reflectors)
    - Sends reminder notification to the user(s) for timely replacement
    - User resettable
  - Able to log data in 15, 30, or 60 second intervals.
AIMS FOR LIGHTHAMMER MKIII – MONITORING DASHBOARD VIEWS
AIMS FOR LIGHTHAMMER MKIII – MONITORING DASHBOARD VIEWS
AIMS FOR LIGHTHAMMER MKIII – MONITORING DASHBOARD VIEWS
### AIMS FOR LIGHT HAMMER MKIII – MONITORING DASHBOARD VIEWS

![Monitoring Dashboard](image)

<table>
<thead>
<tr>
<th>Row ID</th>
<th>Network ID</th>
<th>System Configuration</th>
<th>System Options</th>
<th>Power Level</th>
<th>System State</th>
<th>Fault Code</th>
<th>Warnings</th>
<th>Display</th>
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</tr>
</tbody>
</table>
AIMS FOR LH10 MKIII (W/ INTELLIGENT IRRADIATOR) – NEW PARAMETERS

- The NEW Intelligent Irradiator allows for an additional 12 new parameters to be monitored.
- Total of 80 measured and calculated parameters per system.

![System Data Table](image-url)
AIMS - EXAMPLES OF DIAGNOSTIC CAPABILITY

Magnetron Current Monitor

Magnetron Current Standard Deviation

Magnetron Current Monitoring

Erratic Magnetron

Undamaged magnetron

Magnetron Current Monitoring

Magnetron Current Standard Deviation

Erratic Magnetron

Undamaged magnetron
What is IoT?

- The **"Internet of Things"** (IoT) refers to the ever-growing network of physical objects that feature an IP address for internet connectivity and the communication that occurs between these objects and other Internet-enabled devices and systems which also encompasses technologies such as: *smart grids, smart homes, smart factories, intelligent transportation, smart cities ..........*
- Also known as **"Big Data"** and **"Industry 4.0"**
- Also for Industrial use is call the **"Industrial Internet of Things"** (IIoT)
- The IoT (IIoT) is blurring the boundaries between virtual and physical objects, *enabling entirely new market segments and business models.*
INDUSTRY 4.0

- One of the largest global transformations is occurring in history right now… *digitalization*.
- The fourth industrial revolution (Industry 4.0) holds the promise of integrated digital and physical technologies that improve organizational operations, productivity, growth, and innovation.
DIGITALIZATION STRUCTURE

Digital interfaces
- Customer understanding
- Cross-department interfaces

Manage Data
- Cloud
- Big data
- Cyber security

Business Impact
- Reconfigure for value delivery
- Business models and strategy

Advanced Analytics
- Data Science
- Data Analytics
- Machine learning

Build connectivity
- Data acquisition
- IoT
- Cyber-physical systems
- Technology

Source: Leading Digital: Turning Technology into Business Transformation, George Westerman, Didier Bonnet, Andrew McAfee, October 14 2014
What does this mean to UV Industry?

- Will IoT impact our Industry?
- The correct question is:

  How will IoT impact our Industry?
What is AIMS CLOUD?...

› Real-time transfer and storage of AIMS data to a server in the **Cloud**.
› Ultimately, this data can be used for predictive maintenance/analytics to *avoid unscheduled and often costly system shut downs* at customer sites.
AIMS Cloud, System Architecture

Cloud computing and data base

Push Infrastructure

Push Messages

Incident Alerts
Service Alerts
Maintenance Schedule
View Past History
Diagnostic Support

Service Personnel Mgmt.
Scheduling & Tracking
Reports & Reviews
Remote-commands
AIMS Cloud, Benefits

- The AIMS Cloud platform will revolutionize the way we are providing our customer service support.
  - *Real time data*
  - *Advanced warning and predictive maintenance*
  - *Minimize unscheduled shutdown for customers*
  - *Can monitor customer operation*
  - *Eventually data can be used for spare parts order via ERP if user enables*
  - *New service models can be offered to our customers*
  - *Service to customers can be proactive instead of reactive*
AIMS CLOUD PREDICTIVE

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AIMS CLOUD PREDICTIVE – GLOBALLY INTERCONNECTED REACH

To further build upon this tool, and, to not only prepare but, to become a part of the age of digitization, Industry 4.0, and the “smart factory,” **AIMS CLOUD** will be transformed into something even greater!…using predictive algorithms/analytics, it will provide **Predictive & Actionable Intelligence**!
WHAT IS NEXT?

AIMS CLOUD PREDICTIVE / ANALYTICS PLATFORM – HOW IT WILL WORK

**Features**

- **Dashboards**
  - Real-time operational metrics
  - Actuals vs. fault, warning & normal parameter limits

- **Notification Service**
  - Fault, warning & information notifications
  - Integrated w/email, SMS & issue tracking systems

**Benefits**

- Increase Service Team Efficiency
- Maximize Machine Up Time
- Accelerate Product Innovation
- Lower Cost of Ownership
LIGHT HAMMER MARK III DIGITALIZATION STATUS

Digital interfaces ✓
- Customer understanding
- Cross-department interfaces

Manage Data ✓
- Cloud
- Big data
- Cyber security

Business Impact ●
- Reconfigure for value delivery
- Business models and strategy

Advanced Analytics ✓
- Data Science
- Data Analytics
- Machine learning

Build connectivity ✓
- Data acquisition
- IoT
- Cyber-physical systems
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“THE NEXT GENERATION OF UV CURING SOLUTIONS”