Today’s Agenda

<table>
<thead>
<tr>
<th>Key Problems in Thermal Industry</th>
</tr>
</thead>
<tbody>
<tr>
<td>Evaluation and Decision</td>
</tr>
<tr>
<td>Honeywell Solutions &amp; Applications</td>
</tr>
<tr>
<td>Summary</td>
</tr>
</tbody>
</table>
• *Problem* - Need a control system that helps control costs as well as the process. *(Our existing system was a great controller in its day. But technology today is far better than it was a few years back.)*

• Rising fuel Costs a major concern

• Temperature Control

• Atmosphere control

*Need tools to monitor and implement optimum operating conditions*
Factors impacting profitability

Thin margins and the rising cost of energy and raw materials makes it difficult to compete profitably. The following issues needed to be addressed:

1. Rising Fuel Cost: With rising fuel costs, sloppy control raises natural gas usage levels and adds to the cost of manufacturing.

2. User Unfriendliness: It is difficult to learn how to use the current system, remember all the functions and setup procedures needed to perform a process.

3. Lack of Functionality: The legacy controller didn’t allow storage of time/temperature profiles in the system.

4. Mistakes Erode Profitability: Because of industry-wide thin margins, mistakes often mean that jobs are processed at a loss just to fill the order.
Agenda Contd......

Key Problems in Thermal Industry

Evaluation and Decision

Honeywell Solutions & Applications

Summary
Evaluation and Decision Criteria

• Cost is important, but confidence is even more important.

• Tighter control on the process which whereby increases product quality, reduce gas usage and operating costs

• Temperature control, Profile management and communication with supervisory software packages

• Configuration, startup and implementation time must be minimal.

• Operator friendliness is essential. (Operators must learn new system in a few hours.)

• Complicated temperature cycles, a control system with set-point ramping, as well as multiple set-points is a must.

• Pre-formatted “ready-to-use displays with simple “drag and drop” programming
Management Concerns

1. Advanced control systems can be expensive and difficult to implement.

2. Trial runs on a new system require loss of process for a number of days. Lost production time during the trial is expensive.

3. Will the new system help me comply with all the safety regulations and help enhance savings?

4. What if the investment is made and it doesn’t work?
Agenda Contd…

Key Problems in Thermal Industry

Evaluation and Decision

Honeywell Solutions & Applications

Summary
Solution Details

Controller Module

I/O Modules (4-12 slots)

I/O Status LEDs

Size:
- Height 5.5” 139.7 mm
- Width 10.5” 266.7 mm
- Depth 5.9” 149.9 mm

Power Supply

Serial Ports (RS-232/485)
- Configuration
- Modbus Master/Slave
- Honeywell OI (Integrated 1042/559 or optional 900 CS for retrofit applications)

Ethernet
- Supervisory
- Peer-to-peer
- 900 Control Station
- 1 port on C30 & C50

Remote I/O port (not on C30)

Field Wiring Terminals

Termination Cover & Label
## Input Modules
- 8 pt Universal Analog Input (isolated)
- 16 pt High Level Analog Input
- 4 pt Pulse/Frequency/Quadrature Input
- 16 pt Contact Digital Input
- 16 pt 24 VDC Digital Input
- 32 pt 24 VDC Digital Input
- 16 pt 120/240 VAC, 125 VDC (isolated)
- 16 pt 120/240 VAC Digital Input
- 16 pt 80 to 264 VAC, 80 to 150 VDC (isolated)

## Output Modules
- 4 pt Analog Output, 0-20 mA (isolated)
- 8 pt Analog Output, 0-20 mA
- 16 pt Analog Output, 0-20 mA
- 16 pt 24 VDC Digital Output
- 32 pt 24 VDC Digital Output
- 8 pt 120/240 VAC Digital Output
- 8 pt Relay Output
Function Blocks

- Simply Drag and Drop Function Blocks and “Soft-Wire”

Over 100 Function Block Types!

Click on desired item and drag to diagram

Double-click on block to configure block properties

Double-click on output pin and connect to input pin of another block

- Up to 400 blocks for CPU C30
- Up to 2000 for CPU C50
- Up to 5000 for CPU C70/C70R

Analog Input Dialog box - simple address, input type and range assignment
Recipes

• Writes values into variables
  – Writes to analog & digital variables
• Up to 50 variables per Recipe
• Up to 1310 Recipes in controller
• Load via Control Station
• Load via RCP block
• Recipes can be used to
  – Write a value to any variable
  – Load setpoints
  – Select setpoint programs
  – Set alarm limits
  – Activate control valves
AI Block

Burnout check - T/C's

Filter Time - Digital filter smoothes the input. Configurable the first order lag time constant from 1 to 120 seconds. Noisy Sensor

Bias – To compensate input for drift of an input value due to deterioration of a sensor, or some other cause. Calibration

Range: For Linear Inputs Only
Actuation Input = 4-20mA
Process variable = Flow
Range of Flow = 0 to 250 gal/min
High Range Display Value = 250
Low range Display Value = 0

Failsafe - Value output will go to protect against the effects of failure of the equipment, such as, fuel shut-off if there is loss of flame in a furnace, or a sensor break.

Bad Channel Detection – Un-checking eliminates diagnostic failure indication in controller
AI with Remote CJ Sample Configuration

RCJ input in Deg C

![Diagram of RCJ input in Deg C with process, remote junction panel, and compensated leadwire using copper wire compensated leadwire.]
Process Control – PID Block

**PID Block**
- 2 Setpoints (1 local and 1 remote or 2 local)
- 2 Sets of PID constants (bumpless transfer selection)
- 2 Alarms (2 levels each)
- PID-A or PID-B (only integral response to SP change)
- Feed-forward Input
- Output Tracking of external input
- Logic interface for control of mode (A/M, R/L)
- Logic interface for tuning constant selection, auto-tuning
- Soft-start (output limiting on startup)

**Control Types**
- PID
- Duplex - Heat/Cool (Dual Output)
- Internal Cascade
- Ratio (with bias)
- 3 Position Step
- Position Proportional with actuator slide wire feedback
Accutune

PID Function Block Properties

Accutune III Type
- Disable
- Cycle Tuning
- SP Tuning

Tuning Criteria
- Normal
- Fast

PV Adaptive Tuning
- Disable
- Enable

Enable Fuzzy Overshoot Suppression

OK  Cancel
Fuzzy Overshoot Suppression

- **Accutune III Type**
  - Disable
  - Cycle Tuning
  - SP Tuning

- **Tuning Criteria**
  - Normal
  - Fast

- **PV Adaptive Tuning**
  - Disable
  - Enable

- **Enable Fuzzy Overshoot Suppression**
Cascade Control

PID Function Block Properties

Remote Setpoint Source and Units

- Use RSP Input (EU)
- Use RSP Input (%)
- Use LSP2 (EU)

Primary Controller

Secondary Controller

Heat

Cool
SP Programmer

Library of 99 Profiles in controller
Up to 50 segments each

Setpoint Programmer Function Block
Load Profile by # or Name
Reload on Reset
Edit & Save Profile by #

Running Profile (On-line edits)

1. Profile A
2. Profile B
3. Profile C
4. Profile D
99. Profile ZZ

Using HC Designer:
Copy/Paste/Delete a Profile/Recipe
Save to a file
Upload from a file and add to Profile/Recipe pool
Print a Profile/Recipe
Download selected Profile/Recipe

Edit Profile Segments
Save to pool or file
Load from file

At OI

Up to 50 Segments
SP Ramp/Soak Out
AUX (Soak Only) Out
Time Base
SPP Program Restart after Power Loss

One scan cycle

If Time Off is greater than SET-TOFF, execute Restart
Note execution sequence relative to SPP block

Power loss

SP=PV on power restore

Program continues

*Restore RAMP rate

* must be entered under SP Profile properties
Multi-Zone Semiconductor Tube Furnace (SP Scheduler)

Mass Flowgas

Supply of Different Gas Mixtures

ANALOG OUTPUTS

HC900

ANALOG OUTPUTS

THERMO-COUPLE ZONE 1

THERMO-COUPLE ZONE 2

THERMO-COUPLE ZONE 3

ZONE 1

ZONE 2

ZONE 3

SCR

SCR

SCR

Thermo-couple

ZONETEMPERATURE

BURN OFF FLAME

Event #1

On

Off

On

On

Off

On

On

Off

On

On

Off

On

On

Off

On

On

Off

On
Furnace specific features – Carbon Potential

Carbon Potential

Description
The CARB label stands for Carbon Potential.

Function
A combined Carbon Potential and PID algorithm determines Carbon Potential of furnace atmospheres based on a Zirconium probe input.

Input
- **Probe** = Sensor Input from Al block (0-2000 mV)
- **TEMP** = Temperature Input (°F or °C) from Al block
- **%CO** = Percent Carbon Monoxide 1 100%
- **RSP** = Remote Setpoint Analog Input value in Engineering Units or Percentage (0 1.5)
Dew Point Control

Table 1. Typical dew point levels

<table>
<thead>
<tr>
<th>Dew Point, °F (°C)</th>
<th>Water Vapor (ppm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>+46 (+8)</td>
<td>10,590</td>
</tr>
<tr>
<td>+25 (-4)</td>
<td>4,320</td>
</tr>
<tr>
<td>0 (-18)</td>
<td>1,240</td>
</tr>
<tr>
<td>-40 (-40)</td>
<td>127</td>
</tr>
<tr>
<td>-90 (-68)</td>
<td>3.4</td>
</tr>
</tbody>
</table>

Note: 1.04% moisture = 10,590 ppm water vapor = +46°F dew point

Table 2. Dew point vs. surface carbon (%)

<table>
<thead>
<tr>
<th>Dew Point, °F (°C)</th>
<th>1500 °F</th>
<th>1600 °F</th>
<th>1700 °F</th>
</tr>
</thead>
<tbody>
<tr>
<td>+30 (-1.1)</td>
<td>1.10</td>
<td>0.80</td>
<td>0.55</td>
</tr>
<tr>
<td>+40 (4.4)</td>
<td>0.85</td>
<td>0.60</td>
<td>0.40</td>
</tr>
<tr>
<td>+50 (10)</td>
<td>0.60</td>
<td>0.40</td>
<td>0.27</td>
</tr>
</tbody>
</table>

Dewpoint Calculation

Furnace Properties
- Furnace Factor: 33
- Use Anti-soot Constant: Yes
- Low Temperature Limit: 0
- Celsius: Yes
- Fahrenheit: No

CO Properties
- % CO: 20
- Use Actual % CO: No

O2 Probe Manufacturer
- Unknown
- Advanced Atmosphere Control Corp
- Furnace Control Corp
- Marathon Monitors
- Super Systems Inc.
3-Element Feed water Control

Steam

Drum Level

Feed water Flow

Note: All physical connections are by I/O cards
Air (controlled variable) = Ratio x Fuel (RSP, or wild variable) + BIAS

Ratio Control
Additional Useful Blocks
Totalization & Flow

- **Totalize**
  - Preset
  - Enable
  - Reset
  - Output (accumulated value)
  - ON for one scan when the output = Preset Value

- **Mass Flow**
  - Differential Pressure
  - Gas Pressure
  - Gas Temperature
  - Calculates gas mass flow from differential pressure drop across an orifice plate. The calculation includes square root extraction.

**Totalize Block Properties**
- Block Number 145, Order 21
- Input Rate: Per Second
- Preset Trigger: Decreasing, Increasing
- Preset: Local, Remote

**Mass Flow Properties**
- Block Number 146, Order 22
- Calculation:
  \[ \text{Calc} = Kg \times \text{sqrt} \left( (Kx \times X + Bx) \times (Ky \times Y + By) \times (Kz \times Z + Bz) \right) \]
  - If \( \text{Calc} > \) Low Cutoff then OUT = Calc else OUT = 0
- Set Calculation Parameters:
  - \( K_g \)
  - \( K_x \)
  - \( K_y \)
  - \( K_z \)
  - \( B_x \)
  - \( B_y \)
  - \( B_z \)
  - Low Cutoff
Function Generator

Examples

Figure 37 shows a function block diagram using a FGEN function block to characterize the PID control loop output for control valve operation using 9 breakpoints.

Figure 37 FGEN function block example
Free Form Logic

- It can be used instead of number of logic gate function blocks
  - Boolean expressions may be entered directly in the block
  - Reads digital inputs A through H and calculates the output based on specified Boolean logic function
The Honeywell HC900 meet AMS 2750D requirements for Controlling, Monitoring and Recording Instruments

- Key requirement for Controlling, Monitoring & Recording instruments is a calibrated accuracy (2 F/1.1 C)
900 Control Station Overview

- Contains pre-defined display features and custom display development tools
- Has color display and touch panel user interfaces that enhance process monitoring and simplifies online controller changes
- Uses Station Designer software for configuration
  - Works with HC900 Hybrid Control Designer software to create control station database that is imported from HC900 controller

10 Inch Screen Size

15 Inch Screen Size
HC900 Integration with Experion

- HC900 controllers can be integrated with Experion DCS system for supervisory control and data acquisition
- Can be integrated with Experion PKS, LS and HS systems
- Configured using Quick Builder application
- Uses Universal Modbus Driver for communication
- Redundant controllers can also be integrated with Experion

![Diagram of HC900 Integration with Experion](image)

**HC900 Interface Drivers:**
- Universal Modbus (UMB)
- OPC client
Experion HS – Alarms, Reports, History, Trend
MATRIKON OPC SERVER FOR HC900
Honeywell Offering for Electric Heating

THYRISTORS
HC900 integration with RM7800

Honeywell 7800 Series ensures safe start up and shut of the combustion system.

Honeywell UDC2500 provides critical over temperature protection.

UDC3200 Provides critical loop control back up.
Strength of product reliability and proven field performance.

Quick application start-up time due to HC Designer intuitive software and Accutune III powerful tuning algorithms.

Universal Analog Input Cards

No annual software license fee (HC Designer), no dongle protection.

Free software WEB downloads for product enhancements.

World-wide product support with toll free GTS.

On-Line configuration and monitoring

Synchronized scan rate for implementing effective PID control strategies.

Reduced configuration time with process specific function blocks; Set Point Programmer and Scheduler, Sequencer, PID.

Scalable Experion and HC900 solution set.
Value Proposition for OEM’s and SI’s

- For OEM’s and SI’s in the thermal market that need a safer and more reliable system with low operating costs, eng/startup time, lesser configuration time (half the time required for programming) and increase uptime, Honeywell’s HC900 control system provides a savings of $200K annually with better operating efficiency. HC900 hot-swappable electronic boards allows additional savings in maintenance and repair costs.

- We do this by unifying the best features of continuous and discrete control technology in a highly integrated and open environment, this control system provides accurate PID control along with ramp/soak programming, increased production, and reduced overall maintenance costs.
Today’s HC900 Platform

Small to Large Applications

UDC Family
- UDC3500
- UDC3200
- UDC2500
- UDC1700
- UDC1200
- UDC700
- UDC100

Low-end Process/Thermal applications
- Single / Multi Loop Controllers

HC900
- Thermal applications
- Stand alone/Equipment Control
- Small/Medium Processes
- Continuous accurate process control

Experion
- Server Based
- HS / LS
- Batch
- Med Processes

Small DCS

UDC1700
UDC1200
UDC700
UDC100

UDC3500
UDC3200
UDC2500

Process

Safety

Med Processes

C300, Safety Mgr
- Plant Wide Control
- Med/Large Processes

DCS

Server Based

HS / LS

Batch

Med Processes

UDC1700
UDC1200
UDC700
UDC100

UDC3500
UDC3200
UDC2500

Process

Safety
Applications and Industries

**Thermal**
- Ovens
- Incinerators
- Vacuum Furnaces
- Boilers
- Lehrs
- Soaking Pit
- Glass Furnace
- Autoclave

**Chemical**
- Pigments Production
- Reactors
- Soap Blending
- Alkid Production
- Caustic Flakes Production
- Incinerator
- Lithium Cell Production
- Pilot Plant
- Oil extraction

**Pharma/Bio-Tech**
- Sterilizers
- Incinerators
- Lypholizers
- Fermenters
- Reactors
- Boiler Control
- Clean Room Monitoring
- HVAC

**Power**
- Combustion Control
- Drum Level Control
- Scrubbers
- Evaporators
- Water Treatment
- Feed water Control
- Emissions Monitoring
- Data Acquisition
- Boiler Control

HC900 serves a wide variety of Industries and Applications
## Industry and Applications

<table>
<thead>
<tr>
<th>Type</th>
<th>Industry</th>
<th>Application</th>
<th>Location</th>
<th>Country</th>
</tr>
</thead>
<tbody>
<tr>
<td>End User</td>
<td>Mfg Goods</td>
<td>Furnace Control</td>
<td>Cavite</td>
<td>Philippines</td>
</tr>
<tr>
<td>End User</td>
<td>Thermal</td>
<td>Furnace</td>
<td>China</td>
<td>China</td>
</tr>
<tr>
<td>System Integrator</td>
<td>Steel</td>
<td>Furnace Control, Sinter Plant</td>
<td>Durgapur</td>
<td>India</td>
</tr>
<tr>
<td>System Integrator</td>
<td>Sugar</td>
<td>Boiler, Pan, Mill control</td>
<td>Fiji Island</td>
<td>India</td>
</tr>
<tr>
<td>OEM</td>
<td>Mfg Goods</td>
<td>Boiler Control</td>
<td>Ranjangaon</td>
<td>India</td>
</tr>
<tr>
<td>End User</td>
<td>Pulp &amp; Paper</td>
<td>Boiler</td>
<td>China</td>
<td>China</td>
</tr>
<tr>
<td>System Integrator</td>
<td>Sugar</td>
<td>Boiler, Pan, Mill control</td>
<td>Andhra Pradesh</td>
<td>India</td>
</tr>
<tr>
<td>End User</td>
<td>Thermal</td>
<td>Boiler</td>
<td>China</td>
<td>China</td>
</tr>
<tr>
<td>OEM</td>
<td>Power</td>
<td>Boiler Control</td>
<td>Madurai</td>
<td>India</td>
</tr>
<tr>
<td>End User</td>
<td>Building Automation</td>
<td>Boyle</td>
<td>China</td>
<td>China</td>
</tr>
<tr>
<td>End User</td>
<td>Pharmaceutical</td>
<td>Boiler</td>
<td>China</td>
<td>China</td>
</tr>
<tr>
<td>System Integrator</td>
<td>Sugar</td>
<td>Boiler Control, Mill control</td>
<td>Noida</td>
<td>India</td>
</tr>
<tr>
<td>OEM</td>
<td>Pulp &amp; Paper</td>
<td>Fluidised Bed Boiler Control</td>
<td>Vapi</td>
<td>India</td>
</tr>
<tr>
<td>System Integrator</td>
<td>Thermal</td>
<td>Furnace Control</td>
<td>Bhilai</td>
<td>India</td>
</tr>
<tr>
<td>End User</td>
<td>Thermal</td>
<td>Boiler</td>
<td>China</td>
<td>China</td>
</tr>
<tr>
<td>End User</td>
<td>Sugar</td>
<td>Boiler Control</td>
<td>Tanuku</td>
<td>India</td>
</tr>
<tr>
<td>End User</td>
<td>Metals</td>
<td>Boiler</td>
<td>China</td>
<td>China</td>
</tr>
<tr>
<td>End User</td>
<td>Mfg Goods</td>
<td>Foreheart Furnace Control</td>
<td>Bharuch</td>
<td>India</td>
</tr>
<tr>
<td>End User</td>
<td>Chemical</td>
<td>Boiler Control</td>
<td>China</td>
<td>China</td>
</tr>
<tr>
<td>End User</td>
<td>Power</td>
<td>Boiler</td>
<td>Shanghai</td>
<td>CHINA</td>
</tr>
</tbody>
</table>
**Bodycote – Thermal Treatment Furnace Manufacturer**

- With over 235 facilities in twenty two countries the Bodycote Group, is the Worlds leading supplier of specialist metallurgical services.

- Due to Bodycote’s continued success, a recent expansion at their process plant in the UK, provided an ideal opportunity to select the Honeywell HC900 Hybrid Controller to control the new Nitriding furnace.

- The Nitriding furnace will be used to control critical components for the Automotive Industry.

- The HC900 provides precise multiloop temperature control combined with sequence control.
Therma SPA manufactures machines for the production of thermal energy.

Oil fired boilers, steam generators, thermal-destructors are some examples of the most common machines produced.
THERMA LEADERSHIP team talks about HC900

• We have chosen the HC900 system from Honeywell because of its simplicity of configuration. We can do it ourselves, without relying on any software house, HC900 is not a “black box” for us: both Development and Service Engineers can easily manage to configure it, even on site during start up said Mr Piazza, Therma’s technical director.

• Also we add value to our offer in providing on line maintenance thanks to the ease of remote access to HC900 via GSM / GPRS modems. When a customer gets an issue we can check in few minutes what’s going on and fix it. The customer can be located any wherein the world. It saves both our traveling costs and our customers’ time.

• We are looking forward to using the HC900 redundant controller on some specific boilers.
Key Problems in Thermal Industry

Evaluation and Decision

Honeywell Solutions & Applications

Summary
Summary

• Process control can be challenging and expensive so a good control system is essential to maximize savings

• Energy Savings, Increased production and efficient fuel control achieved by efficient deterministic control strategy

• Our ONE Honeywell Solution (HC900 with CS900 or Experion HS, RM7800, thyristors, pressure, flow, temperature transmitters) is a perfect blend for your thermal automation needs
HC900 documentation

• HC900 Control System

• HC900 Hybrid Controller

• Hybrid Control Designer

• 900CS Control Station
  http://hpsweb.honeywell.com/Cultures/en-US/Products/Instrumentation/hybrid/HC900Interfaces/default.htm
Please call me if you would like to talk about the product, features, problems/issues/improvements, segmentation, or marketing requirements

Cell – 7709002953 – Praveen Jose