Commercial vs. Industrial Controls for Data Centers

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Sources of HVAC Problems

From a 60 building study performed by Lawrence Berkeley National Laboratories
Sources of Control System Problems

From a 60 building study performed by Lawrence Berkeley National Laboratories
Types of Control Systems

- BAS/Commercial Systems
- PLC/SCADA Systems
- Distributed Control Systems

Cost Performance
Types of Control Systems
Which are used in Semiconductor Facilities?

- Commercial Controls
- PLC/SCADA Controls
## Control System Vendors

<table>
<thead>
<tr>
<th></th>
<th>General Electric</th>
<th>Allen Bradley</th>
<th>Schneider/Invensys</th>
<th>Siemens</th>
<th>Honeywell</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>BAS</strong></td>
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<tr>
<td><strong>PLC</strong></td>
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<tr>
<td><strong>SCADA</strong></td>
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<tr>
<td><strong>DCS</strong></td>
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</table>
Control System Elements

Devices
- Inputs
- Outputs

Controllers & I/O Modules
- PLC = Programmable Logic Controller (Industrial)
- DDC = Direct Digital Controller (Commercial)

Networks
- Controllers to I/O or lower level controllers
- Supervisory system to Controllers

Supervisory Systems
- SCADA = Supervisory Control and Data Acquisition (Industrial)
- BAS = Building Automation System (Commercial)
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Devices

Input

Commercial

Temperature Sensor - Johnson Controls

Liquid Pressure Sensor - Dwyer DSGT

~ 100 USD

~ 500 USD

Industrial

Temperature Sensor - Minco Eurostyle

Liquid Pressure Sensor - Rosemount 3051

~ 500 USD

~ 2000 USD
Devices
Output

<table>
<thead>
<tr>
<th>Commercial</th>
<th>Industrial</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electric Damper Actuator - Belimo AFA24-SR US</td>
<td>Pneumatic Damper Actuator - HyTork XL</td>
</tr>
<tr>
<td>~ 300 USD</td>
<td>~ 1500 USD</td>
</tr>
<tr>
<td>Electric Control Valve - Johnson Controls VG 700</td>
<td>Pneumatic Control Valve – Fisher Baumann</td>
</tr>
<tr>
<td>~ 300 USD</td>
<td>~ 1500 USD</td>
</tr>
</tbody>
</table>
Devices
Industrial

More rugged
More accurate
More repeatable
Less drift
Easier maintenance/calibration
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## Controllers

### Commercial

- **Small DDC**
  - Siemens MEC

### Industrial

- **Small PLC**
  - Allen Bradley Compact Logix
- **Large PLC**
  - Modicon Quantum

- **Large DDC**
  - Johnson Metasys NCE
Controllers
Industrial

More rugged
More memory
Faster scan
Richer instruction set
Higher resolution I/O Modules
Possible redundancy options
Higher MTBF, lower MTTR

Availability = \frac{MTBF}{MTBF + MTTR}

[MTBF = Mean Time Between Failure, MTTR = Mean Time To Repair]
Controllers Scan Rate

Time required for one cycle

Read Inputs → Solve Logic → Write Outputs

PLC = Milliseconds  DDC = Seconds
Controllers
Industrial - Redundant Processors
Controllers
Industrial - Redundant Power Supplies
Controllers
Commercial System Programming
Controllers
Industrial - Function Block Programming - Exterior
Controllers

Where is programming power required?

Simple Air Handler - NO!
Controllers
Where is programming power required?

Complex Air Handler - YES!
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Networks
Industrial

Higher performance
Higher reliability / availability
Better environmental tolerance
Can be deterministic
Redundancy options
Better diagnostics
Easier maintenance
Networks
Industrial Redundant Network Cables
Control System Elements

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Supervisory Systems
Commercial - BAS Representation
Supervisory Systems
Industrial - SCADA Representation
Supervisory Systems
Industrial – SCADA

- Faster updates
- Faster data logging
- Multiple clients
- Better connectivity
- Redundancy options
Supervisory Systems
Industrial - SCADA Trending

SQL Database
• Accepts High Speed Data
• Compatible with redundant historical servers
• Security and audit trail for government regulations
Supervisory Systems
Industrial - Redundant SCADA Servers
Things you can do with Industrial Controls
Emergency Power Restart

- KVA
- Generator Capacity

Seconds

KVA

Graph: Time vs. KVA with Generator Capacity.

X-axis: Seconds (0-400)
Y-axis: KVA (0-16000)

Legend:
- KVA
- Generator Capacity
Things you can do with Industrial Controls
Energy Savings

How many pumps should run?
Things you can do with Industrial Controls

Energy Savings

3 pumps @ 59% speed = 378 KW

2 pumps @ 93% speed = 420 KW

Easy to do in PLC
Not so easy in a DDC
Chiller Plant Optimization
More things you can do with Industrial Controls

Redundancy vs. Passive automation
Fast PID loops (e.g. pressure control)
Site wide temperature/humidity control
OPC Link with other systems
Things you can do with Commercial Controls

Use pre-programmed HVAC sequences
Scheduling capability
  (night setback, holidays…)
Link with lighting, security systems
Purchase a service contract
Consequences of Cooling System Failure

25º F in 10 minutes @40 W/sq-ft

From White Paper - “Continuous Cooling is Required for Continuous Availability” - Uptime Institute
Summary
Where to use Industrial Controls: High Tech Cleanrooms
Summary Where to use Industrial Controls
High Density Data Centers
Summary Where to use Commercial Controls
High School Cafeterias
High Performance Controls Architecture Enables Advanced Energy Management Strategy at Vantage Data Centers

The prevalent HVAC controls solution in data centers and other mission critical facilities is typically a DDC (direct digital control). Some owners and operators have specified and implemented PLCs (programmable logic controllers) to take advantage of the performance and reliability a PLC based control system can offer. As we continue to push the limits to become more efficient, the control algorithms become more complex, a high performance PLC can be a better solution. Vantage Data Centers has implemented a state of the art facility wide PLC based building management system at their Santa Clara campus. During this session Vantage Data Centers will discuss the benefits in energy efficiency and performance they have realized from implementing PLCs for their HVAC controls. We will also review the pros and cons of implementing a DDC vs. PLC in data center BMS systems.

**Justin Harp**
Director of Operations Engineering
Vantage Data Centers

**Warren Jackson**
Mission Critical Industry Manager
GE Intelligent Platforms
Appendix – PCW - P&ID - sample
Process Cooling Water System Pressure Control:
Two differential pressure transmitters (PDIT-201-00-30 and PDIT-201-00-31) monitor the pressure between the supply and return lines in the distribution. The signal(s) from operator selected transmitters are averaged and the calculated value is used as the input to a PID loop controlling all the operating pumps. The output of the loop pressure controller regulates the speed of the pumps through speed-indicating controllers that vary the output frequency of each operating pump’s VFD and sequences the pumps as described above.

If a sensor fails as indicated by loss of signal (below 4ma) an alarm is generated and the sensor is removed from the loop calculation. The signal select block also alarms if the delta between signals exceeds a threshold value. If that occurs, an alarm is generated and the signal furthest from loop setpoint is removed from the calculation. If there are no valid sensor signals the PID loop is placed in manual mode and held at its last value.
Appendix – PCW - SCADA Screen
Appendix – PCW - Instrument Submittals - example

Vee-Ball Valves

Fisher® Vee-Ball™
V150, V200 and V300 Rotary Control Valves

This bulletin covers the NPS 1 through 2, NPS 3 through 12 Series B, and the NPS 14 through 20 V150, V200 and V300 Vee-Ball control valves (shown in figure 1). The Vee-Ball valve combines globe valve ruggedness with the efficiency of a rotary valve. A shearing action between the V-notch ball and the ball seat (figure 2) promotes smooth, nonclogging operation. The unrestricted straightthrough flow design provides high capacity for gas, steam, liquids, and viscous slurries.

V150, V200, and V300 valves mate with a variety of ASME raised face flanges, as well as with DIN flanges (see Specifications).

To meet specific application requirements, a variety of metal and soft ball seal materials are available. A splined drive shaft combines with a variety of power operated and manual actuators to provide reliable, high-performance throttling or on-off control for many different applications in the process industries.

Unless otherwise noted, all NACE references are to NACE MR0175-2002.

Technical Information

Deltabar M PMD55
Differential pressure measurement
Differential pressure transmitter with metal sensor
Communication via HART, PROFIBUS PA or FOUNDATION Fieldbus

PCIT-CW-00-20 M81-8124A
PCIT-CWH-00-20 M81-8121A
PCIT-CW-00-10 M81-0130A
PART NO. PMD55-CD21BD61L/G/HJ/A1A+AAD1PBZ1

Application

The Deltabar M differential pressure transmitter is used for the following measuring tasks:

- Flow measurements using orifice flange in conjunction with primary elements in gas, vapours and liquids
- Level, volume or mass measurement in liquids
- Differential pressure monitoring, e.g. of filters and pumps

Your benefits

- Reference accuracy ± 0.1 %
- Platinum resistor, up to ± 0.05%
- Temperature range up to 100°C
- Compact transmitter design
- Quick commissioning via DIP switches
- Basic and multi-ranged operation
- Send via display module
- RS 4 to 20 mA with HART
- via PROFIBUS PA
- via FOUNDATION Fieldbus
- Continuously adjustable for differential pressure, temperature and flow (Deltabar M, Deltabar M Centaur 50, e.g.)
- Protective display
- Universal electronics
- International rangeability over a wide range of operating conditions

Endress+Hauser

People for Process Automation

IDC ARCHITECTS