

A Specification Guide for Performance Monitoring Systems

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About the Project



- Project Goal: Facilitate improved building operation and energy efficiency by providing better information to staff and commissioning practitioners
- Primary Task: Develop a specification of performance monitoring capabilities to be added to bid packages for control systems

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Contributors



Team:

- LBNL
- PG&E
- QuEST
- Shockman Consulting
- The Deringer Group
- Fred Smothers and Associates
- Project Advisory Group
- Reviewers

Partners:

- GSA
- CA DGS
- UC & CSU
- Navy
- 3rd Party Property Management Firm

Funding:

- CEC PIER
- DOE BT
- PG&E ET

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Performance Monitoring Systems



- Provides means to easily assess the current and historical performance of the whole building/facility, and its significant energy consuming systems and components
- Includes sensors, wiring and data acquisition devices, plus the means to calculate, display and archive resultant parameters – performance metrics
- Contained within a direct digital control (DDC) system or as a separate stand alone energy information system (EIS) or as a combination of the two
- DDC offers a viable platform
- New construction or new installation/ upgrade project in an existing building

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Why develop specifications?



- Help facilitate demand for better systems → market pull
- Provide the means to get the data required to establish building performance.
 - EIS vendors have made a start in the marketplace, but even they are inhibited by the lack of quality data.
- Educate owners, specifiers and installing contractors
 - Good measurement practice
 - Need to provide a proper point naming convention and beneficial data displays.

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Development Process




1. Engage an interested group of large institutional and commercial building owners to develop actual specifications for the installation of performance monitoring systems at their facilities
2. Based on specifications developed in actual projects, drafted a general specification for performance monitoring systems.
3. Obtain feedback from a wide range of stakeholders and interested parties.
4. Based on this feedback, we created the specification guide.

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Specification Focus




- Performance metrics
 - Calculated indicators of building, system and equipment performance
 - kWh/ft²/yr, COP or kW/ton, kW/cfm
- Measurement system requirements
 - Higher accuracy measurements
 - Proper sensors and sensor installation
 - Btu meters, air flow monitoring stations
- Data acquisition and archiving
 - 1 minute trend data
 - Seamless access to real time and historical data
- Data visualization and reporting
 - Data tables, reports
 - Interactive pre-defined plots (time series, XY, carpet)




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Elements of the General Specification




- Performance Metrics and Data Points
- Instrumentation
- Data Point Naming Conventions
- Data Archival
- Graphics Requirements
- Commissioning
- Training
- Submittals



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Requirements by Class



- Basic: typically applied to a single building which may have built up systems including air handlers, boilers and a chilled water plant; owner desires essential monitoring requirements
- Intermediate: typically applied to conventional buildings with built up systems which include air handlers, boilers and a chilled water plant; owner desires progressive monitoring requirements
- Advanced: typically applied to exotic buildings, campuses or critical facilities with special requirements, which have complex systems such as co-generation or self generation; owner desires sophisticated monitoring requirements.

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Table 1 – Recommended Performance Monitoring Requirements

Requirement	Class 1 - Basic	Class 2 - Intermediate	Class 3 - Advanced Diagnostics
Data Displays			
Equipment/System Graphic	Floor plan with zones temperatures; system graphic with performance data; equipment graphic	Add performance data to equipment graphic	
Data Tables	Building air handler summary table, metrics results table	Expand building air handler summary table, add floor zone table, expand metrics results table to include additional metrics	Expand metric results table to include additional metrics
Time Series Group Trend Plots	System performance plots	Add equipment performance plots	Add system and equipment diagnostic plots
XY Group Trend Plots	Basic plant and whole building based XY plots.	Add equipment based XY plots:	Add X-Y plot diagnostics:

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Table 1 – Recommended Performance Monitoring Requirements

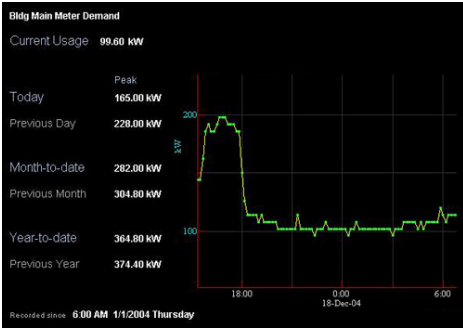
Requirement	Class 1 - Basic	Class 2 - Intermediate	Class 3 - Advanced Diagnostics
Points			
Measured			
Virtual			
Calculated – Whole Building			
Calculated – Chilled Water			
Calculated – Natural Gas Equipment			
Calculated – Supply Air			
Database Software			
Assumptions	Measurement of HVAC system equipment power is easily accomplished; System is capable of calculating time based metrics and displaying X-Y plots.		

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Example Point Peak Data Table Graphic



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Example Point Names

Point Name	Point Description	Point Type	Trend Group
MnACISFVFD S/S	Supply Fan Start/Stop	DO	A1
MnACISFVFD CmdV	Supply Fan Speed Command Voltage	AO	A1
MnACISFVFD Cmd%	Supply Fan Speed Command in %	Soft	
MnACISFVFD CmdHz	Supply Fan Speed Command in Hertz	Soft	A1, AN1a
MnACISFVFD Status	Supply Fan Status	MB	A1, AN1a
MnACISFVFD Alarm	Supply Fan VFD Alarm	MB	A1, AN1a
MnACISFVFD In Local	VFD in local "hand" mode	MB	A1, AN1a
MnACISFVFD Hz	VFD output frequency in Hz	MB	A1, AN1a
MnACISFVFD Power	VFD output power in kW	MB	AN1a
MnACISA StcPres	Supply Duct Static Pressure	AI	A1
MnACISFHiStcPres Alarm	Supply Fan - High Static Pressure Alarm	DI	A1
MnACIRFVFD S/S	Return Fan Start/Stop	DO	B1
MnACIRFVFD CmdV	Return Fan Speed Command Voltage	AO	B1
MnACIRFVFD Cmd%	Return Fan Speed Command in %	Soft	
MnACIRFVFD CmdHz	Return Fan Speed Command in Hertz	Soft	B1, AN1b

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Tech Transfer - I



- Prepared example specification for chilled water plant monitoring for ASHRAE Guideline Project Committee 22P: *Instrumentation for Monitoring Central Chilled Water Plant Efficiency*.
- General Spec included as a resource in ASHRAE's "Scoping Study: Protocols for Measuring and Reporting On-site Performance of Buildings Except Low-Rise Residential Buildings", 1/22/2006.

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Tech Transfer - II



- Submitted material from Appendix G, H, and I to ASHRAE's standing guideline revision for inclusion in Guideline 13
- Specification guide provided to ASHRAE Technical Committee 1.4 Green Controls subcommittee to help develop a reference guide for LEED

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Tech Transfer – III



- Specification guide posted on-line in support of the California Title 24 2008 development process. Current draft:
<http://cbs.lbl.gov/performance-monitoring/specifications/>

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Next Steps - I



- Update the Specification Guide with the following additional guidance:
 - How to select and install instrumentation properly
 - How to verify through-system accuracy of specified metrics
 - Spec language to support LEED performance metrics (e.g., IAQ), and cost-based metrics
 - Methods for establishing benchmarks of expected performance (whole-building/system/equipment)

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Next Steps - II



- Determine how to best tailor specifications, including summary reports for different applications.
- Document costs/benefits of specified performance monitoring

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Conclusions



- Completed the development of usable performance monitoring specifications
- Significant interest and anticipated uptake at national and state levels
- Determining costs and benefits presents challenges

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