

HVAC Energy Efficiency – Challenges & Opportunities: How to Approach to Realizing the Potential

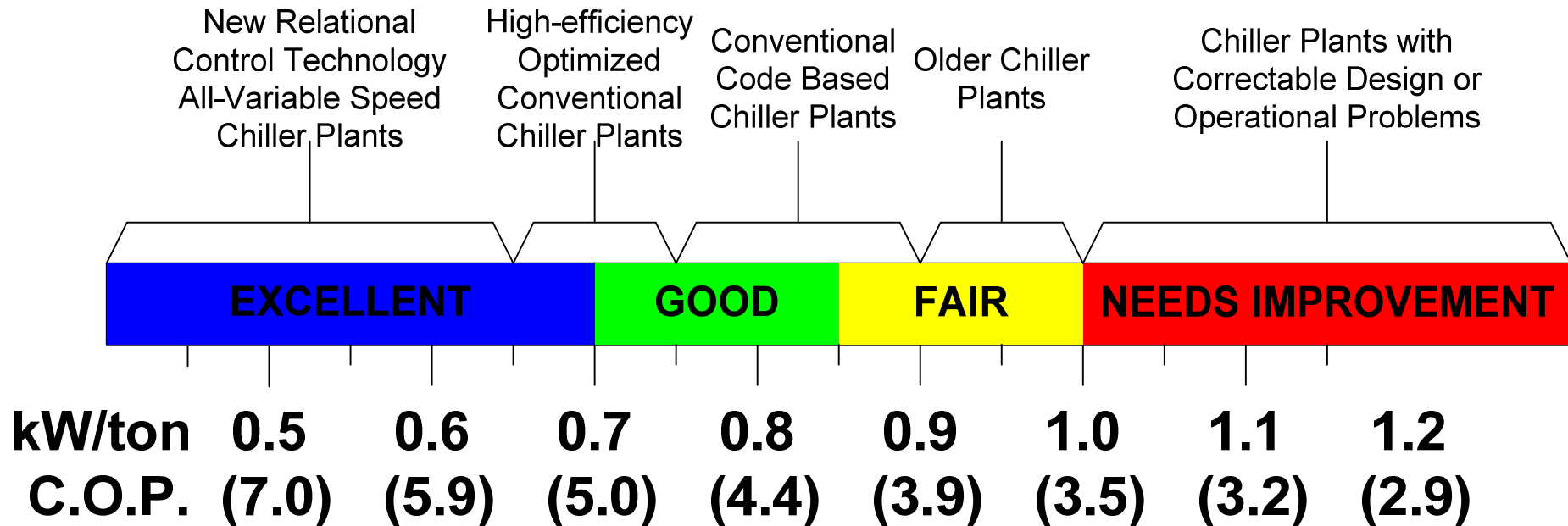
Part 2: Performance Based Project Design & Implementation

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Presentation Agenda

1. Why Focus on Performance?
2. Who Should be Responsible for Performance?
3. Organizing Building Projects to ensure Performance:
4. Setting Goals and Standards for Performance that are Attainable.
5. Questions, Comments, & Discussion

Chiller Plant Energy Use Spectrum



AVERAGE ANNUAL CHILLER PLANT EFFICIENCY IN KW/TON (C.O.P.)
(Input energy includes chillers, condenser pumps, tower fans and all chilled water pumping)

Based on Chiller Plants with electrically driven chillers in comfort cooling applications with 42°F (5.5°C) Design Chilled Water Supply Temperature with open cooling towers designed for 85°F (29.4°C) Leaving Tower Water Temperature at Design Full Load Conditions

Why New Design & Implementation Strategies are needed for Performance Focused Technologies

1. Many buildings and systems are designed and constructed without specific energy performance goals or targets
2. Most buildings with energy performance goals or targets fail to meet them at startup.
3. For the few buildings that have energy ambitious but achievable performance goals or targets, and manage to meet them at startup, almost none are able to maintain them over time.

Why New Procurement & Contracting Strategies are needed for Performance Focused Technologies

1. Bidding process makes it difficult to consider non-standard solutions.
2. The requirement for equals at the bidding process stifles development of new technologies.
3. Even if superior performing equipment is acquired, the disjointed contracting process makes actually achieving performance and maintaining it over time difficult.

Design/Implementation Strategies for Performance Focused Technologies

1. Include energy performance criteria in equipment specifications and include instrumentation/trending in controls scope so that energy performance can be assessed.
2. Include a requirement for overall annual performance of chiller plant and other sub-systems and assign one entity in the contract the responsibility and authority to ensure it is achieved.
3. Include ongoing (at least 5 years) performance verification, reporting, and troubleshooting support services as a part of the construction contract to ensure specified system performance criteria are maintained over time.

Cooling Tower Energy Performance Example

SECTION 236500 - COOLING TOWERS

1.4 PERFORMANCE REQUIREMENTS

C. Cooling Tower Fluid Flow Range:

1. Cooling Tower shall be capable of operating throughout a range of liquid flows from a design maximum of 450 gpm to a minimum of 180 gpm. Spray nozzles shall be designed to provide complete coverage of all tower fill over the full range of liquid flow
2. Cooling Tower shall be capable of fan operation from 100% fan speed to 25% fan speed with a VFD ready motor and fan drive designed for that range of speeds.

Cooling Tower Energy Performance Example

SECTION 236500 - COOLING TOWERS

1.4 PERFORMANCE REQUIREMENTS (continued)

D. Minimum Overall Tower Performance:

1. Overall Cooling Tower Performance is based its capacity to cool condenser water supplied to it from the chiller condenser.
2. Full Load Design Conditions: Cooling Tower shall be capable of cooling 450gpm of condenser water from 95°F to 85°F in a 79°F wet bulb temperature environment with Tower fan operating at full speed not exceeding 10HP. This operation point shall be CTI certified for the tower.

Cooling Tower Energy Performance Example

SECTION 236500 - COOLING TOWERS

1.4 PERFORMANCE REQUIREMENTS

D. Minimum Overall Tower Performance: (continued)

3. Low Load Conditions. Cooling Tower shall be capable of cooling 180 gpm of condenser water from 73.5°F to 66°F in a 60°F wet bulb temperature environment with Tower fan operating at 40% speed not exceeding 1 HP. This operation point shall be certified for the tower by its manufacturer.

Overall System Energy Performance Example

SECTION 230910 RELATIONAL CONTROL OPTIMIZATION 1.4 SYSTEM PERFORMANCE

D. Relational Control Optimization System Energy Performance

1. Relational Control Optimization Hardware/Software shall achieve and maintain the following energy performance throughout the warranty period:
 - a) Hartman LOOP chiller plant optimization or other relational control as required to provide a fully verified total chiller plant operating efficiency (including chillers, condenser pumps, tower fans and chilled water pumps) of 0.59/kW ton on an annual basis based on plant equipment provided.

Overall System Energy Performance Example

SECTION 230910 RELATIONAL CONTROL OPTIMIZATION 1.4 SYSTEM PERFORMANCE

D. Relational Control Optimization System Energy Performance

1. Relational Control Optimization Hardware/Software shall achieve and maintain the following energy performance throughout the warranty period: (continued)
 - b) TRAV variable air volume system optimization or other approved relational control regimen to provide a fully verified total VAV system overall fan system operating efficiency of 2.0 kWh per square foot in air system efficiency.

Overall System Energy Performance Example

SECTION 230910 RELATIONAL CONTROL OPTIMIZATION 1.4 SYSTEM PERFORMANCE

D. Relational Control Optimization System Energy Performance

1. Relational Control Optimization Hardware/Software shall achieve and maintain the following energy performance throughout the warranty period: (continued)
 - c) Zone and subzone control that provides temperature/humidity monitoring and response for every separate office along with integrated lighting control and response to individual thermal comfort/lighting requests.

Overall System Energy Performance Example

SECTION 230910 RELATIONAL CONTROL OPTIMIZATION 1.4 SYSTEM PERFORMANCE

D. Relational Control Optimization System Energy Performance

1. Relational Control Optimization Hardware/Software shall achieve and maintain the following energy performance throughout the warranty period: (continued)
 - d) An overall total annual HVAC/lighting energy use target of less than 12 kWh/SF for the entire facility.

Ongoing Energy Performance Verification & Reporting Example

SECTION 230910 RELATIONAL CONTROL OPTIMIZATION 3.5 ENERGY PERFORMANCE DEMONSTRATION, REPORTING AND VERIFICATION

- A. Engage a factory authorized Relational Control representative to start up and verify required energy and other performance criteria for each system...
- B. Provide ongoing real-time monitoring of the performance of each system and provide daily troubleshooting assistance to operations staff if any system shows performance beyond the minimum energy performance criteria listed in this Section.

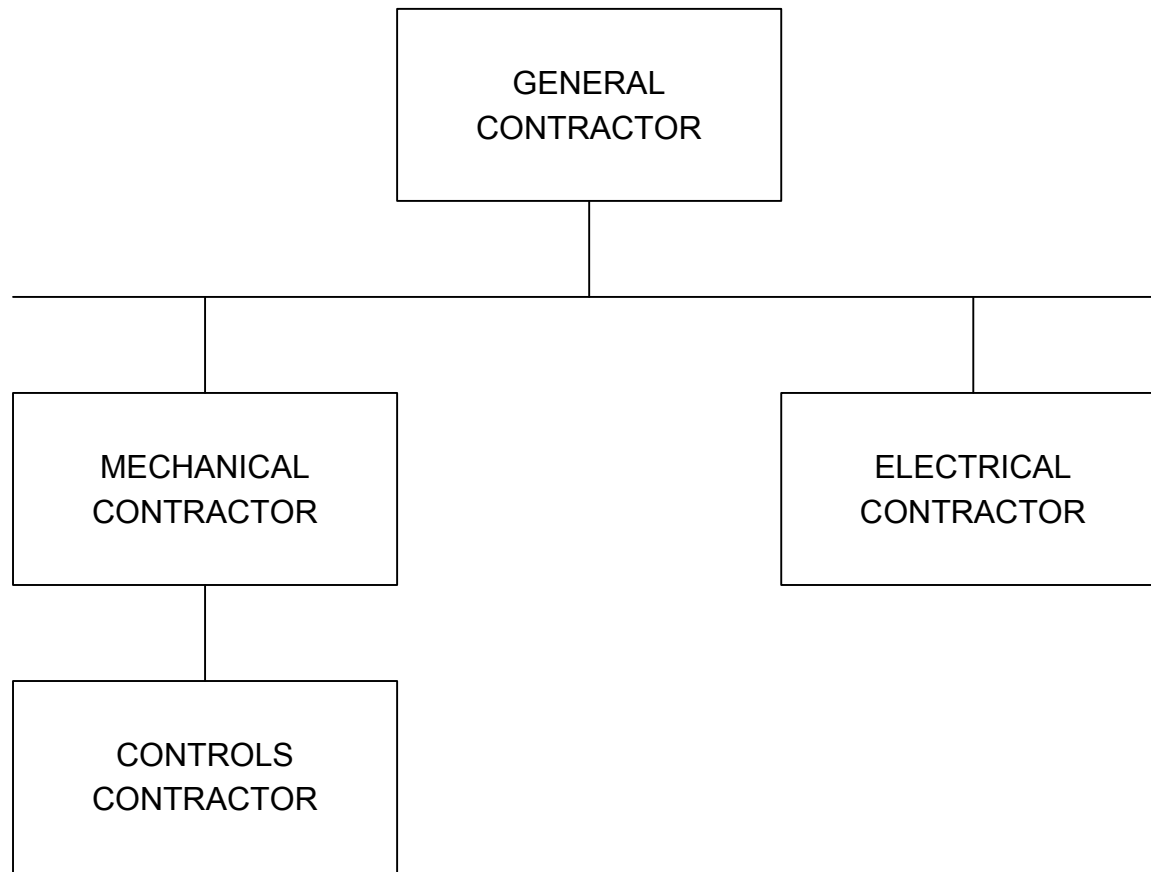
Ongoing Energy Performance Verification & Reporting Example

SECTION 230910 RELATIONAL CONTROL OPTIMIZATION 3.5 ENERGY PERFORMANCE DEMONSTRATION, REPORTING AND VERIFICATION(continued)

- C. Provide monthly or Quarterly performance as determined by the Owner that show the energy performance of each system and facility compared to minimum requirements listed in this Section. Provide explanations and recommended corrective action for any elements that do not meet the minimum energy performance criteria listed in this Section.
- D. Above performance support services shall be provided for 5 (five) years beyond the Owner's acceptance of the building.

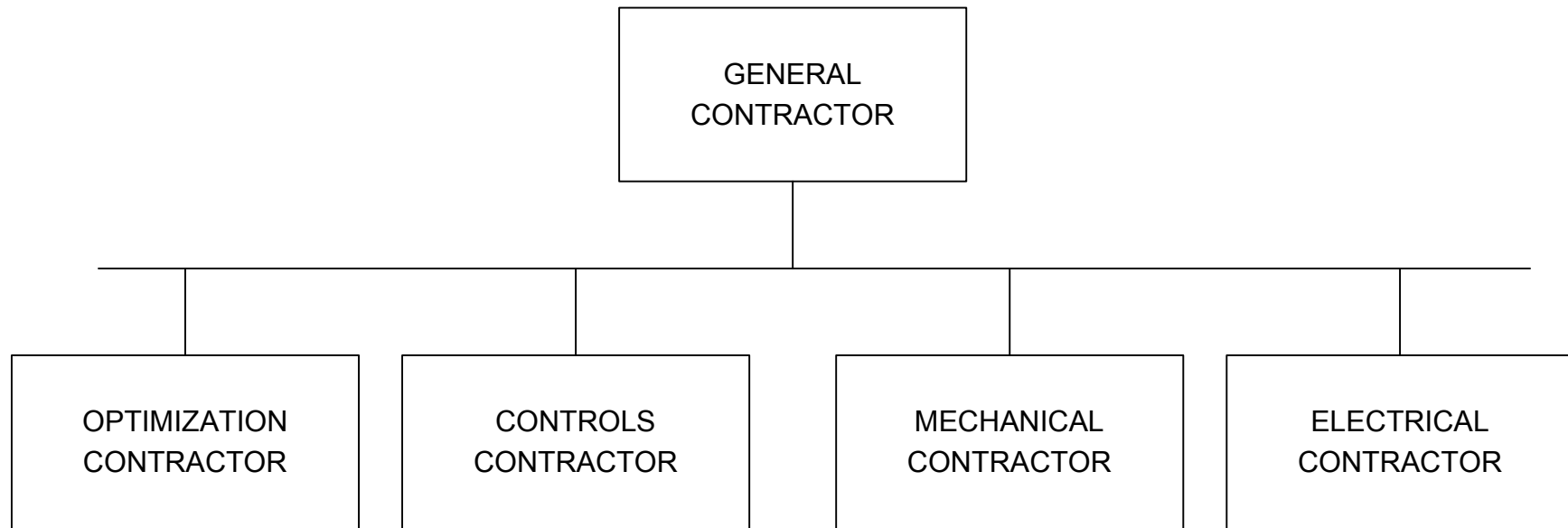
Reorganizing the Construction Team for Performance Focused Technologies

Typical Current Construction Team Structure



Reorganizing the Construction Team for Performance Focused Technologies

Recommended Construction Team Structure



Achieving Ultra-Efficient All-Variable Speed Building Systems

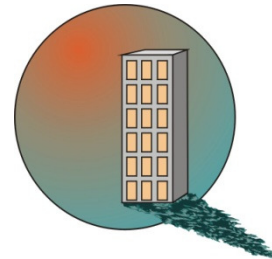
1. Configure all-variable speed systems and design/specify Relational Control or other proven technology to achieve ultra-efficient performance
2. Adapt new ***design/implementation procedure and structure*** along with new technologies to ensure ***performance focused*** design, construction and operations.
3. Add capability to monitor and provide regular reporting of ***system performance*** to the project scope to ensure success is achieved and maintained over time.

Improving Efficiency of HVAC Systems

Part 2: Performance Based Project Design & Implementation

Questions, Comments, Discussion

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