DATA CENTER ENERGY MANAGEMENT

Management, Organizational, and Technical Best Practices*

1. **Eleven Management & Organizational Best Practices** — maximizing energy efficiency while maintaining - if not improving - data center performance and reliability is not just a matter of substituting better technologies and operational procedures. The broader institutional context of the design and decision-making processes must also be addressed, as follows:

    (01) Institute an **energy management program**, integrated with other functions (risk management, cost control, quality assurance, employee recognition, and training).

    (02) Use **life-cycle-cost-analysis** as a decision-making tool, including energy price volatility and non-energy benefits (e.g. reliability, environmental impacts).

    (03) Create **design intent documents** to help involve all key stakeholders, and keep the team on the same page, while clarifying and preserving the rationale for key design decisions.

    (04) Adopt **quantifiable goals** based on Best Practices.

    (05) Minimize construction and operating costs by **introducing energy optimization** at the earliest phases of design; avoid excessive/redundant "safety margins" and “right size” to trim first costs.

    (06) Include **integrated monitoring, measuring and controls** in the facility design.

    (07) **Benchmark** existing facilities, track performance, and assess opportunities.

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(08) Incorporate a comprehensive **commissioning** (quality assurance) process for construction and retrofit projects. [download report **|** links and other resources]

(09) Include **periodic "re-commissioning"** in the overall facility maintenance program.

(10) Evaluate the potential for **on-site power generation**, including combined power technologies.

(11) Ensure that all facility operations staff receives **site-specific training** on identification and proper operation of energy-efficiency features.

2. Sixty-six Technical Best Practices:

A. Mechanical: Airflow Management — the efficiency and effectiveness of a datacenter conditioning system is heavily influenced by the path, temperature, and quantity of cooling air delivered to the IT equipment and waste hot air removed from the equipment.

i) Eliminate Mixing and Recirculation of Hot Equipment Exhaust Air

(01) Hot Aisle/Cold Aisle

(02) Rigid Enclosures

(03) Flexible Strip Curtains

(04) Blank Unused Rack Positions

(05) Design for IT Airflow Configuration

(06) Select Racks with Good Internal Airflow

ii) Maximize Return Air Temperature by Supplying Air Directly to the Loads

(07) Use Appropriate Diffusers

(08) Position Supply and Returns to Minimize Mixing and Short Circuiting

(09) Minimize Air Leaks in Raised Floor Systems

(10) Optimize Location of Computer Room Air Conditioners

(11) Provide Adequately Sized Return Plenum or Ceiling Height

(12) Provide Adequately Sized Supply

(13) Use an Appropriate Pressure in Under-floor Supply Plenums

B. Mechanical: Air Handler Systems — the air handler fan is typically the second largest energy use in the mechanical system, and can even exceed the energy use of the cooling plant in some cases. Optimizing the air handler system for datacenter use, as opposed to relying on traditional air-handler design rules developed over years of office system design, is essential to achieve an efficient and cost effective system.

i) Minimize Fan Power Requirements

(14) Low Pressure Drop System Design

(15) Use Redundant Air Handler Capacity in Normal Operation

ii) Use an Optimized Airside Economizer

(16) Implement an Airside Economizer

(17) Design for Medium Temperature Air

(18) Control to Avoid Unnecessary Humidity Loads

iii) Use Large Centralized Air Handlers

(19) Use Load Diversity to Minimize Fan Power Use

(20) Optimize Air Handler for Fan Efficiency and Low Pressure Drop

(21) Configure Redundancy to Reduce Fan Power Use in Normal Operation

(22) Use Premium Efficiency Motors and Fans

(23) Control Volume by Variable Speed Drive on Fans Based on Space Temperature

C. Mechanical: Humidification — Humidification specifications and systems have often been found to be excessive and/or wasteful in datacenter facilities. A careful, site specific design approach to these energy-intensive systems is usually needed to avoid energy waste.

i) Design System to Actual Equipment Requirements

(24) Use Widest Suitable Humidity Control Band

(25) Specify Humidity Sensor Calibration Schedule

(26) Provide Appropriate Sensor Redundancy

(27) Control Humidity with Dedicated Outdoor Air Unit

ii) Eliminate Over Humidification and/or Dehumidification

(28) Ensure Proper Economizer Lockout

(29) Maintain Coil Temperature Above 55°F

(30) Centralize Humidity Control

iii) Use Efficient Humidification Technology

(31) Use Waste Return Air Heat to Humidify

(32) Use Adiabatic Humidifiers for Humidity and Evaporative Cooling

(33) Use Lower Power Humidification Technology

D. Mechanical: Plant Optimization — when a chilled water plant is used, all the standard design best practices apply, with a few additions. The unusual nature of a datacenter load, which is mostly independent of outside air temperature and solar loads, makes free cooling very attractive and increases the importance of efficiency over first cost. In addition, the typical level of redundancy and reliability can influence the value of various design options.

i) Maximize the Chiller System Efficiency

(34) Select Chiller for High Efficiency

(35) Implement an Aggressive Condenser Water Reset

(36) Minimize Tower Fan Power and Size Towers for Close Approach

(37) Use Free Cooling / Waterside Economization

(38) Use a Medium-Temperature Chilled Water Loop

(39) Use Primary Only Variable Flow Chilled Water Pumping

(40) Consider Thermal Storage

(41) Monitor System Efficiency

(42) Right-size the Cooling Plant

E. IT Equipment: Selection — the IT equipment is the reason for the facility Increasingly, there are reasonable opportunities to increase the efficiency of IT equipment, reducing the need for mechanical infrastructure and ongoing energy use directly at the load level through the selection of IT equipment.

i) Specify Efficient Server Equipment

(43) Specify High Efficiency Power Supplies

(44) Consider Equipment Power Consumption in Specifications

ii) Use Cooled Equipment Racks

(45) Use Equipment Racks with Integral Coil

(46) Consider Direct Liquid Cooling

F. Electrical Infrastructure — Protection from power loss is a common characteristic of datacenter facilities. Such protection comes at a significant first cost price, and carries a continuous power usage cost that can be reduced through careful design and selection.

i) Design UPS System for Efficiency

(47) Maximize Unit Loading

ii) Select Most Efficient UPS Possible

(48) Specify Minimum Unit Efficiency at Expected Load Points

(49) Evaluate UPS Technologies for Most Efficient

(50) Do Not Over-specify Power Conditioning Requirements

iii) Use Self-Generation for Large Installation

(51) Eliminate Standby Generator

(52) Recover Waste Heat for Local Heating Uses

(53) Recover Waste Heat for Datacenter Cooling Use

(54) Eliminate UPS Systems

G. Lighting — Datacenters are typically lightly occupied. While lighting is a small portion of the total power usage of a datacenter, it can often be safely reduced through mature, inexpensive technologies and designs.

i) Use Active Sensors to Shutoff Lights When Datacenter is Unoccupied

(55) Occupancy Sensors

ii) Design Light Circuiting and Switching to Allow for Greater Manual Control

(56) Bi-Level Lighting

(57) Task Lighting

H. Commissioning and Retrocommissioning — an efficient datacenter not only requires a reliable and efficient design, it also requires proper construction and operation of the space. Commissioning is a methodical and thorough process to ensure the systems are installed and operating correctly in all aspects, including efficiency.

i) Engage Additional Design Expertise for Review and Guidance.

(58) Perform a Peer Review

(59) Engage a Commissioning Agent

ii) Perform System Commissioning

(60) Document Testing of All Equipment and Control Sequences

(61) Measure Equipment Energy Efficiency Onsite

(62) Provide Appropriate Budget and Scheduling for Commissioning

(63) Perform Full Operational Testing of All Equipment

iii) Perform Retrocommissioning

(64) Perform a Full Retrocommissioning

(65) Recalibrate All Control Sensors

(66) Where Appropriate, Install Efficiency-Monitoring Equipment

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* US EPA & Lawrence Berkeley National Laboratories