DATA CENTER DESIGN
OVERVIEW
Presented by Horst Pfendt
Critical Facilities Round Table
7th QUARTERLY MEETING
December 17, 2004
DATA CENTER DESIGN OVERVIEW

INTRODUCTION

In the next couple of hours I will touch on various aspects of Data Center Design.

The intend today, is not to have a detailed discussion, but to have an overview only of various elements of Data Center Design.

The goal is to get feed-back in what topics the group is interested in so we can schedule a more detailed presentation in the future.
DATA CENTER DESIGN
OVERVIEW

The following items will be discussed:
- Project Development and Execution Process
- Organizing and Staffing
- Building Design: Interior/Exterior
- Power Distribution
- Process Cooling
- Commissioning
- Energy Efficiency
The Project Development and Execution Process (PDEP) consists of five phases:

1. Identify and Assess Opportunities
   - Clearly frame the goal to be pursued and ensure alignment with business objectives
   - Perform a preliminary assessment of uncertainties and associated risks
   - Plan for the next phase of the process
DATA CENTER DESIGN

OVERVIEW

PDEP (continued)

2. *Generate and Select Alternatives*

- Generate alternatives and reduce the uncertainties of each alternative
- Develop the expected value for selected alternatives & select the preferred alternative
- Plan for the next phase of the process
PDEP (continued)

3. *Develop Preferred Alternatives*
   - Fully define the scope of the alternatives & develop detailed execution plans
   - Check for expected value to meet business objectives
   - Refine estimates & economic analysis to meet funding requirements
   - Submit for funding approval, as appropriate
DATA CENTER DESIGN

OVERVIEW

PDEP (continued)

4. **Execute**
   - Implement execution plan and finalize operating plan
   - Collect, analyze, and share metrics and lessons learned
PDEP (continued)

5. *Operate and Evaluate*

- Monitor performance of the asset
- Benchmark performance of the assets against objectives and competitors
- Share results and lessons learned
- Continue performance assessment and identify other opportunities
DESIGN AND CONSTRUCTION ORGANIZATION

DESIGN & CONSTRUCTION MANAGER

OFFICE FACILITY PLANNING COORDINATOR

DESIGN & CONSTRUCTION COORDINATOR

FIELD REPRESENTATIVE

- REVIEW SHOP DNGS
- INTERFERENCE DNGS
- INSPECTION
- SPARE PARTS
- MAINTENANCE PROCEDURES
- OPERATIONS INSTRUCTIONS
- "AS-BUILT" DNGS

DESIGN/CONSTRUCTION

- INSTALLATION AND FACILITY PLANNING
- OPERATIONS
- OFFICE BUILDINGS
- ENGINEERING DEPT.
- ARCHITECT
- CONSULTANT
  - ELECTRICAL
  - MECHANICAL
  - STRUCTURAL
  - SEISMIC
  - FIRE PROTECTION
  - PHYSICAL SECURITY
  - BUILDING MANAGEMENT
  - ACOUSTIC
  - SIGNAGE
  - AUDIO VISUAL
  - ELEVATOR
DATA CENTER DESIGN
OVERVIEW

Organization and Staffing

- Project Manager familiar with Company Policy/Operation
- In-House Personnel; i.e. Building Engineer
- Architect
- Asset Protection Consultant
- Electrical Consultant
- Mechanical Consultant
- Structural Consultant
- Data Center Relocation Team
DATA CENTER DESIGN
OVERVIEW

Site Selection
- New/Old/Own/Lease/Outsource Building
- Environmental Hazards
- Transportation
- Access to Site
- Utility Service
- Telecommunication Service
DATA CENTER DESIGN
OVERVIEW

Project Total Data Center Requirements in sq. ft.

- Hardware Requirements
- Power Requirements
- Process Cooling Requirement
- Access Floor Requirement
- Support Space (Non-Raised Floor)
- Circulating Areas
DATA CENTER DESIGN

OVERVIEW

- Exterior Consideration
  - Utility
  - Access to Data Center
  - Security
  - Wall and roof Construction
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OVERVIEW

Interior Consideration
- Floors
- Walls
- Building Column Spacing
- Hallways
- Freight Elevator
- Storage/Uncrating Area
- Power Distribution
- Process Cooling
- Water Detection
Commissioning

- Commissioning is a process that extends through all phases of the project.
- The goal of commissioning is to obtain a facility that operates efficiently, according to the design intent.
Commissioning (continued)

- Commissioning:
  - Provides owners with a facility that operates in accordance with original design intent
  - Reduces energy and operating costs by having systems function at maximum efficiency
  - Reduces the number of contractor call backs
  - Reduces Occupant complaints due to discomfort
  - Provides documentation, training and education for operators and facility managers
Commissioning (continued)

- The following should be in the commissioning specification
  - Responsibilities of parties involved in the project
  - Description of the commissioning process
  - Requirements for pre-functional performance test
  - Requirements for functional performance test
  - Requirements for O&M manuals
  - Requirements for O&M training
  - Requirements for documentation
  - Requirements for “as-built” drawings
DATA CENTER DESIGN

OVERVIEW

Energy Efficiency

Energy Efficiency vs. Energy Conservation

...Both activities lower energy consumption. However, conservation implies a decrease in service; energy efficiency must meet or exceed the quality of service that it replaces...
Energy Efficiency

- We use the EPA’s five-step approach in our energy efficiency management plan
  - Lighting efficiency upgrade (Green Lights)
  - Building tune-up (re-commissioning)
  - Building load reduction
  - HVAC distribution system upgrades
  - HVAC plant upgrade
Core Energy Processes

The five core energy processes and their relationship to one another are shown below.

These processes apply to both energy management and purchasing.

Examples:

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<tr>
<th>Management</th>
<th>Measure</th>
<th>Think</th>
<th>Act</th>
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<tr>
<td>Fuel usage of product too high</td>
<td>Determine that furnace is not properly tuned</td>
<td>Adjust controls, perform maintenance as needed</td>
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<td>Energy cost increases</td>
<td>Evaluate rate alternatives</td>
<td>Change rate schedule or intervene in rate case</td>
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DATA CENTER DESIGN
OVERVIEW

Energy Efficiency Case Study
Office/Warehouse Building

- Benefits of Green Lights Program
  - Environmental
    - Reduced Power Plant emission-1,000,000 KWH/Year
    - Eliminated PCB Ballasts
  - Reduced Energy Costs
    - Energy Savings-$115,000/year
    - PG&E Rebate-$60,000
    - Project Payout <Nine Month
Energy Efficiency Case Study
Office/Warehouse Building (continued)

- Benefits of Mechanical Upgrades
  - Reduced Energy Usage
    - Electrical Savings: 249,600 KWH/Year
    - Demand Savings: 249KW
    - Gas Savings: 1,416 Therms/Year
  - Reduced Energy Costs
    - Energy Savings: $80,000/Year
    - PG&E Rebate: $60,000
    - Project Payback: < 2 Years
### Dublin Warehouse Energy Consumption

**Conversion Factors:**
- \( KWh \rightarrow kW = 0.001 \times KWh \)
- \( MW \\rightarrow kWh = 1000 \times kWh \)

**Note:** Entries

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**Total:** 1,582,221 | 43,759 | 1,626,279 | 43,759 | 1,660,248 | 1660.25 | 1,660.25 | 1660.25 | 1660.25

**Month:** Jan-91 to Dec-91

**Conversion:** CEI = 1000 / kW

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RAISED FLOOR SUPPORTS, SEE ARCH. DWGS. CLOSELY COORDINATE BEFORE PIPING LAYOUT AND INSTALLATION.

ATTACH CONTROL AIR PIPING TO CHNR. AT EACH SUPPORT AND BETWEEN SUPPORTS USING METALLIC BANDS.

LATERAL FLOOR PANEL SUPPORT (HANG), VERIFY EXACT DIMENSION WITH RAISED FLOOR MANUFACTURER.

COMPUTER RAISED FLOOR, BY OTHERS.

CHWS & CHNR TYPICAL.

PROVIDE ACORN NUTS AT ALL EXPOSED BOLT ENDS, TYP.

WELD PIPE CONTINUOUSLY TO 6" x 6" x 1/4" STEEL PLATE.

1-1/2" B X 2" ANCHOR BOLT, 4 PER PLATE.

NOTE:
PROTECT CONTROL AIR PIPING FROM CHNR PIPE TO FAN COIL UNIT CONNECTION BY RUNNING PIPING WITHIN A FLEXIBLE METALLIC CONDUIT. SECURELY FASTEN CONDUIT AT BOTH ENDS.

PIPE SUPPORT DETAIL

MG.08 NOT TO SCALE
**TYPICAL SUPPORT DETAIL FOR DISTRIBUTION PIPING**

**DETAIL NOTES:**

1. Uni-Strut piping supports shall be used only at distribution piping 2-1/2" and smaller.

2. All piping larger than 2-1/2" shall be supported as per detail 7/MG.00 flat-on-top. Provide eccentric reducers as required.
COMPUTER ROOM

FAN COIL UNIT - PIPING DIAGRAM

NOTE: PNEUMATIC CONTROL CONNECTION FAN COIL UNIT BY CONTROLS CONTRACTOR.
DE SANGIO, NO. 75
SWIVEL INLET
ADAPTER, 2-1/2"
TIPT, TYP.

DE SANGIO HOSE COUPLING, 2-1/2"
NO. 95, MALE ONLY, TYP.

PROVIDED BY MECHANICAL CONTRACTOR.

Hose shall be shop fabricated
in 6'-0" lengths using (2)
hose couplings and two (2)
swivel inlet adapter, pressure
and leak tested in accordance
with specifications.

2-1/2" Threaded x 2-1/2" Flange Adapter, TYP.

NOTE: ENTIRE ASSEMBLY INSTALLED BY MECHANICAL CONTRACTOR

COMPUTER ROOM FAN COIL UNIT

PIPING CONNECTION DETAIL

2

NOT TO SCALE