Design Intent Narrative

Report 1

Physical Sciences Building

Project ID: 970770 | 10/7/99

Design Intent Contact:		Commission Provider 1:	
Owner Company:	UCSC	Commission Provider 2:	
Owner:	David Tanza	Construction Manager:	
Architect:		General	
Mechanical Designer:			
Electrical Designer:			
Bldg_Use_Type:	Physical Science	Size:	78500 Sq Ft
Code_Occu_Group:	B2	Stories:	2
Phase Design Intent Tool was started:	Programming	% Floor Area in Labs:	66.00%

Introduction

The purpose of this document is to communicate the approved Design Intent and to initiate an iterative dialog between the A/E and the owner for developing the design basis and performance objectives and metrics for which the A/E is responsible to complete. The A/E shall examine and consider all elements of the Design Intent Narrative in developing Performance Objectives and Metrics. Supplemental information may be required and furnished during the development of the design. Incorporating such information shall be considered within the Scope of Work defined in this document.

Design Intent Overview

The complete Design Intent is a repository to archive a clear and concise record of the design and performance objectives and metrics for this building project and the criteria that are used to evaluate the achievement of theses objectives and metrics.

Initial Design Objectives are provided in this document. Each objective presents a qualitative value importanat to the owner. The A/E shall review each qualitative objective presented and provide and appropriate description of how their design will meet each objective by developing one or more Performance Objectives.

Eventually one or more quantitative Performance Metrics shall be determined for each Performance Objective for such issues as: laboratory classification; life-cycle cost pay-back period; lab cleanliness classification; and energy use per CFM. When stipulated, the A/E shall analyze all quantitative metrics presented and provide an appropriate account of how their design met the metric by completing an Assessment Form.

The following gives a single Design Objective statement for each given Design Objective Category. One or more Performance Objectives and Metrics will or have been developed for each Design Objective Statement.

Design Area: Architectural Programming

Building Standards

This shall use the following four publications to summarize recommendations that pertain to the energy efficiency of this laboratory. They are:

- Occupational Safety and Health Administration (OSHA) - 29 CFR - Part 1910.1450
- "American National Standard for Laboratory Ventilation." ANS/AIHA Z9.5 1992 [King, 1992]
- American Society of Heating, Refrigeration, and Air-conditioning Engineers (ASHRAE), 1991 Applications Handbook. Atlanta, GA.: ASHRAE, 1994. [1991 Applications Handbook, 1994]

- Industrial Ventilation: A Manual of Recommended Practice - 22nd Edition. ISBN: 1-882417-09-7 (ACGIH). The American Conference of Governmental Industrial Hygienists, Inc., eds. Cincinnati, OH: Publisher, 1995. [Industrial Ventilation: A Manual of Recommended Practice - 22nd Edition, 1995]

Resolve conflicting recommendations.

Consider orienting offices to not face south and west, relocation due to solar gain.

Modular Laboratories

One of the most important strategies to incorporate flexibility in a laboratory-type facility is to provide modular systems. The main energy-use benefit of the modular research laboratory is the flexibility it provides to arrange the environmental conditioning systems efficiently. The modules can accommodate a wide range of mechanical and electrical systems with a broad variety of energy-efficiency features. These modules can expand incrementally to provide enough physical space for initial use, and for future growth.

First Cost

Minimize first cost without eliminating energy efficiency features.

Building Codes

Comply with applicable building codes

Usable Space for Laboratories

Theoretical research offices and the associated research laboratories shall be in close proximity. Theoreticians typically work in their offices with direct access to a utility corridor preferred. The office size for theoreticians and experimenters should be the same. Research space for each group's experimenters should be contiguous.

Utility Services

Providing orderly pathways and routing for these will reduce energy use and space requirements and make future maintenance easier. Optimize utility runs by evaluating lab equipment types.

Provide efficient horizontal and vertical pathways for the ducts and pipes required for HVAC, plumbing, communications, and electric power. This shall require a great deal of coordination among the researchers, designers, and engineers. The location of these pathways is normally determined by the facility's function, systems access, and first cost and does not consider the energy waste incurred by inefficient routing of these services.

Conduit paths to roof for future HVAC equipment [optimize utility runs]. Use shorter runs between mechanical distribution panels and VFDs.

Life-Cycle Cost

Choose system designs that have the lowest life-cycle cost. Life-cycle cost (LCC) analysis is the most rational, objective method for selecting the optimum HVAC system for a laboratory facility. Through LCC analysis, all factors that influence total system cost can be identified and quantified. Subjective factors such as fuel cost adjustments, component reliability, and maintenance costs are also included. LCC analysis can be used to assess the economic consequences of any decision by comparing two or more alternatives.

Operational Cost

Consider operational cost in evaluation energy efficiency options. A life-cycle cost analysis does not need to be extremely complex to yield reasonably accurate figures for first and operational costs. It is very important for the energy engineer to consider the optimum mix of operational and first costs to determine the system's life-cycle cost. Life-cycle cost (LCC) analysis accounts for all costs incurred for the HVAC system from installation through a chosen period of time, usually 20 years.

Design Area: Right Sizing

Load Management Analysis

Provide a thorough analysis of the expected loads to manage their energy consumption. Review [expected] heat gain from lab equipment. Use GreenStar equipment in lieu of obsolete equipment. Identify all cleanroom requirements [load management]. Exact motor sizes needed for electrical calculations [load management]

Conditioning Variability Analysis

Consider deleting air conditioning in labs. Justify need for A/C per load calculations.

Air-Flow Rate

Reduce lab air level – what is required? – vary with use. Define face velocity of hoods to address energy use and safety.

System Capacity Analysis

Incorporate "Right Sizing" of mechanical systems and equipment. Carefully calculate laboratory load to provide efficient operation to match loading (to eliminate standby energy needs). Evaluate current and future A/C requirements in labs [right sizing].

Design Area: Supply Systems

Chillers

Consider chiller efficiencies by accounting for the related pumping costs due to the pressure drop through the chiller. Consider open drive chillers tin lieu of Freon-cooled chillers. Verify if this will reduce energy use because cooling the motors is not required. Consider inexpensively ventilating the chiller room to remove the heat from the motors. Consider Absorption chiller vs. centrifugal type.

Consider dedicated process chiller.

Boilers

Use high-efficiency modular boilers to allow staged operation of the plant to match the laboratory's heating load. Consider using isolation valves to prevent circulation during inoperative periods.

Fan Systems

Consider the most efficient fan "system". Consider lowering system static pressure and improving fan efficiency. Consider the use of centrifugal fans for efficiency (fans add heat to the air stream). Consider the use of direct drive fan/motor combinations as opposed standard V-belt drives and synchronous belt systems. Consider motor efficiency.

Air-Handling Units

Examine reducing overall AHU pressure drop. Consider the following items: lowering coil face velocity, filter loading and VFDs, adding bypass dampers (if it can be determined that some AHU components will only be utilized during a portion of the year). Evaluate inlet and outlet configurations of the AHU to avoid inefficient physical restrictions imposed by architectural considerations.

Add bypass dampers at AHU to allow partial shut down of non-occupied space

Energy Recovery Systems

Consider extracting heat from the facility's exhaust air stream before it is vented outside. Energy recovery from the laboratory's exhaust should be considered when significant portions of operating hours are at ambient temperature of 50'F (10'C) and below. When properly designed, these energy recovery systems can reduce installed HVAC system capacity by one-half; reduce operating energy from one-third to two-thirds, depending upon mode of operation; and have life-cycle cost paybacks from immediate to three years. The four major energy-recovery systems include run-around coil systems, regenerative heat wheels, heat pipes, and fixed-plate exchangers.

For example, waste heat in the process cooling water from the laboratory equipment can be recovered. Water chiller waste-heat can provide domestic hot water and space heating for laboratories and offices with a run-around coil system.

Consider energy recovery systems side-by-side exhaust and supply ducting (regenerative heat wheels, heat pipes, fixed-plate exchangers).

Consider energy recovery from fume hood exhaust to pre-heat supply air.

Rank Each Systems Energy Impact

Consider displacing conventional cooling and heating energy with natural ventilation. Consider use of evaporative cooling and economizers.

Energy-Efficient Features

During cool weather, the outside ambient temperature can help save energy in chilled-water systems. The low temperature of the cooling tower water supply enables free cooling of research laboratories, computer rooms, and office buildings. This free cooling is possible if the central plant incorporates a plate-and-frame heat exchanger to provide chilled water production, which means the chiller's compressor can be shut down. Free cooling can be used to save energy whenever the outside wet-bulb temperature drops below the required chilled water set point. This energy-efficiency measure can save enough compressor electric power to pay for plate-and-frame heat exchanger installation costs in less than two years.

Consider a small heat exchanger located on every other floor to separate central system cooling water from lab equipment cooling water system. The cooling water discharge from each piece of lab equipment will gravity drain to a holding tank located on every other floor. A small pump will draw cooling water from the tank. The cooling water is then pumped through a heat exchanger and to the supply side of each piece of lab equipment. Appropriate pressure and make-up water controls will be necessary for each piece of lab equipment connected to the cooling water system.

Consider Domestic and industrial hot water exchanger to delete gas hot water heaters.

Ensure Atrium is purged for night pre-cooling. Operate Night pre-cooling of engineering block.

Consider Chilled water storage or ice storage system.

Apply more passive aspects to atrium cooling system.

Consider backup generator or cogenerator combined with chiller system.

Design Area: Distribution Systems

Delivery of Air and Water

Consider recirculation of cleanroom air systems (reduce both the unidirectional airflow rate and the pressure drop in the air recirculation loop). Review efficiencies of make-up air systems.

Analyze VAV vs. CAV

Piping Layout

Isolate piped utilities at each lab

Noise Attenuation

Acoustical attenuators, used to reduce a fan's sound, increase the pressure drop of the AHU. Consider the disadvantages of high-efficiency but noisy fans that will require acoustical attenuation devices. These devices can negate the energy savings from face velocity reductions.

Supply Air Distribution

Use ceiling fans in the office wing to increase air movement.

Location of Supply Diffusers

Use [special] diffusers in high fume hood density labs

Large-Area Coils

Consider placing fans upstream from the cooling coil and evaporative cooler. In cooling mode, fan heat enhances operation of the cooling coil, and, in heating mode, the same fan heat is used to provide humidification energy and to displace preheat energy input.

Laboratory Pressure Control System

Evaluate engineering wing pressure control system for Labs. Use zone pressure sensor at fume hood

Pumps and System Piping

Install Heating hot water pumps with VFDs. Full port ball valves at all locations [to lower piping system pressure drop]. Use VFD in lieu of modulating valves.

Ductwork Layout

Evaluate configuration of duct to avoid inefficiencies and restrictions

Primary/Secondary Piping Network

Separate hot water pipe loop for offices with auto control for occupied hours

Wind Modeling

Wind modeling of the facility will be performed to optimize lab exhaust stack heights and positions.

Design Area: Filtration Systems

Low Face Velocity

Consider reduction in the required fan horsepower for cleanrooms by using different airflow velocity through the HEPA filtered air, while the remainder of the cleanroom operates at a lower velocity.

Design Area: Lighting Systems

Calculations and design aides

Consider shading of windows in lighting calculations. Review shading with landscape – take into account in calculations

Energy efficient design

Review location of artificial light vs. daylight. Delete incandescent lighting; use fluorescent lighting. Interconnect lighting controls with building management.

Ambient lighting

Use Remote on/off and dimmers at conference and seminar rooms.

Task lighting

Evaluate Task lighting at benches.

Daylighting

Energy efficient lighting evaluations included a large component from natural day lighting in the perimeter office spaces. Specify glazing that is appropriate for glazing orientation. Maximize day lighting but minimize heat gain.

Efficient lighting components

Consider the efficiency and thermal factors of light fixtures. Delete incandescent lighting.

Lighting controls (interior)

Install interior light controls as part of VAV controls (sensor turns off VAV). Use dimmers at floor lights.

Glazing Options

Consider heat mirror glazing vs. low -E type. Size of windows at east, south, and west with overhangs and 100% operable.

Design Area: Commissioning

Commissioning Plan

Hire an Independent commissioning agent.

Design Area: Exhaust Systems

Fume Hoods

Evaluate fume hoods; should they be all VAV; all CAV? Evaluate fume hood size and number of walk-ins. Consider capacity of fume hod exhaust system for future expansion. Define hood sizes to ensure excessive exhaust volume is remove from facility.

Face Velocity

Fume hood sash height and face velocity - define

Exhaust Stack Effluent Dispersion

Wind tunnel model for all of Science Hill

Stack Height

Wind modeling of the facility will be performed to optimize lab exhaust stack heights and positions.

Exhaust Air Volume

Define sash opening height to determine exhaust air volume.

Exhaust Fans and Systems

Consider using Strobic Air exhaust fans.

Design Area: Building Automation System

Control Layout

Tie new controls into main controls at campus

Control System Specification

Allow multiple control manufacturers and bidders, initially.