



State of Utah

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Division of Facilities Construction and Management

DAVID G. BUXTON  
Director

## ADDENDUM #4

Date: February 4, 2009

To: Contractors

From: Vic Middleton, Project Manager, DFCM

Reference: Bingham Entrepreneurship & Engineering Center  
Utah State University - Vernal, Utah  
DFCM Project No. 08273770

Subject: **Addendum No. 4**

Pages	<u>Addendum</u>	40 pages
	Total	40 pages

**Note:** *This Addendum shall be included as part of the Contract Documents. Items in this Addendum apply to all drawings and specification sections whether referenced or not involving the portion of the work added, deleted, modified, or otherwise addressed in the Addendum. Acknowledge receipt of this Addendum in the space provided on the Bid Form. Failure to do so may subject the Bidder to Disqualification.*

While we contend that SB220 should only be potentially applicable to a contract issued after the effective date of said bill, this is to clarify that for purposes of this contract, regardless of the execution or effective dates of this contract, the status of Utah Law and remedies available to the State of Utah and DFCM, as it relates to any matter referred to or affected by said SB220, shall be the Utah law in effect at the time of the issuance of this Addendum.

4.1 **SCHEDULE CHANGES** – There are no changes to the project schedule.

4.2 **GENERAL** – See attached “Addendum No. 04”

**Utah!**  
Where ideas connect

# **BINGHAM ENTREPRENEURSHIP & ENGINEERING CENTER**

**UTAH STATE UNIVERSITY**

**DFCM Project # 08273770**

## **ADDENDA #4**

1. There are several rooms that have contradictions between the written program descriptions, the pdf floor plans, and the Revit files. Some examples of this are:

**Cold Room (BC-RCold)** indicates in the written program that the pre-fabricated cold storage room is by owner, but the pdf floor plan says “in contract”.

**A: Cold room equipment is (NIC)**

**Chemistry Storage – Instrument Room, Large (BC-RS2)** lists work surfaces & shelving under the millwork section of the written program. The pdf floor plan shows these areas as “storage cabinets (NIC)”. The revit file shows them as countertops.

**A: These are cabinets and they are by owner (NIC)**

**Tiered Lecture Hall (BC-TC2)** lists lab equipment as being included in the written description of the program, but the floor plan does not show any lab equipment in this room. Also, this appears to be the only room that lists lab equipment as being included in the contract.

**A: All lab equipment is by the owner (NIC) This room does not have any lab equipment.**

**Open Office Spaces (OSEC-01)** calls for wood shelves under the millwork section of the written program but the pdf plan indicates that they are NIC. The Revit file shows them as furniture.

**A: The shelving in this room is (NIC)**

**Small conference (EC Conference)** calls for wood built-in bookcases in the written program and the pdf floor plan, but the Revit file shows them drawn the same way as the bookshelves in other rooms that are part of the furniture package.

**A: Bookcases are (NIC)**

**EC Reference room (EC-Ref)** calls out 30' built-in wood bookcases in the written program, but the pdf floor plan only shows them as being about 20' long and they are labeled as (NIC). The Revit file lists them as furniture.

**A: Wood bookcases and magazine rack are (NIC) Actual dimensions will vary with design build team geometries in final layout.**

2. Is there a matrix available that specifically identifies which components of the lab casework / equipment are to be provided by contractor and which ones will be provided by owner?

**A: No, needs to be part of the team proposal and tell the owner what they will be getting. Should be information provided by team lab consultant.**

3. The specifications contain information for both wood lab casework and metal lab casework. Is there a definition as to which specific areas will be wood and which ones will be metal?

**A: Undecided at this time. Will make decision at next user meeting.**

4. Is there a specification available for the fixed seating?

## SECTION 126100 - FIXED AUDIENCE SEATING

### 1.1 SUMMARY

- A. Fixed Audience Seating:
1. Pedestal mounting.
  2. Molded-plastic chairs with upholstered inserts.

### 1.2 WARRANTY

- A. Materials and Workmanship: 10 years.

### 1.3 MATERIALS

- A. Fabric: Krypton, 100,000 or more double-rub.

### 1.4 FIXED AUDIENCE SEATING

- A. Chair Mounting:
1. Pedestal: Floor-attached.

- a. Material: Prefinished steel.
- B. Plastic Chairs: Two piece.
  - 1. Back: Smooth surface with upholstered inserts.
  - 2. Seat: Smooth surface with upholstered inserts.
- C. Back Height: Standard-style backs.
- D. Back Pitch: Variable, hinged (rocker).
- E. Tablet Arms: Manufacturer's standard-size, foldaway tablet arm with plastic-laminate writing surface.

END OF SECTION 126100

- 5. The technical specifications provide information for projection screens, but the program indicates in several locations that the power projection screens are (NIC). Please clarify who is responsible to provide these.  
A: All projector screens are powered and they are in the contract.
- 6. Is there a survey or site plan available showing existing power, phone, TV, etc.  
A: As provided in user meeting #1. May be a updated version available prior to submittals.
- 7. Will design follow USU electrical design standards or Just DFCM design standards  
A: DFCM Standards.
- 8. Confirm emergency generator will be included in design
  - a. Egress Lighting, Life Safety Systems, Security, Telecom, Other  
A: Emergency Generator is in the contract. Will have a more information on next users meeting.
- 9. Will there be security systems?
  - a. CCTV camera system, Door Contacts, Break Glass sensors, Motion Sensors
  - b. Access controls: card access, keypads, biometrics  
A: Security systems will be by the owner (NIC) Design build team to coordinate locations with owner. The contractor will provide necessary conduit to these locations. Access controls will be in the contract and will be on all exterior door's and some interior door's. Will provide more information at next users meeting.

10. Will there be any TV distribution, Cable TV service or satellite TV service?

A: No (NIC). Contractor to provide necessary conduit to locations specified..

11. Does the facility need Fiber utility service if available?

A: Will be part of the contract. Specifications to follow.

12. Will there be a Clock System included in the design?

A: No

13. Will there be any daylighting controls in the design?

A: Design build team will include if required by final design proposal.

14. Re: Addendum #2, dated January 12, 2009

**A. Re: pg 237, section 7.00 Design Criteria**

Could you please verify that the USU Design Criteria, dated May 2002, provided with the program documents is the most current version? If not where is the current version available? The USU website says "under construction" for this item.

The USU criteria addresses several proprietary or limited vendor items (i.e. fire alarm, site lighting, automated controls, etc.), do these apply to the Uinta Basin Campus as well?

A: The May 2002 is the most current version for the university. Most of the USU standards would not apply being as the campus is not going to be maintained by the USU main campus. The exception would be with the fire marshal from the university will be performing the inspections and maintenance so the fire alarm and sprinkler system need to conform to USU standards.

**B. Re: pg 237, par. 5**

It is stated: It is the responsibility of the Design-Builder to ... coordinate with local entities for all utilities, easements, rights-of-ways, road conditions (current and future), and other requirements. The cost of permits, hook-up fees, coordination, and any additional surveys needed for this project will be the responsibility of the Design-Builder, and must be included in the GMP.

It is my experience that we will provide design parameters, agree to routing, schedule installations, etc. with utility providers. However, legal descriptions, easement documents, service agreements have been provided for and executed by the Owner (DFCM or USU). Please clarify if this is the intent of "coordinate"?

It has also been my recent experience that permits and utility impact fees are handled by an allowance designated by DFCM within the GMP and the State gets involved with negotiating reasonable impact fees with the local jurisdictions. This is due to the fact that they are in a much better position to leverage reasonable charges

commensurate with the projects actual use impact. Do you really want these fees included in the GMP other than as an allowance?

A: No, they are not to be included in the GMP. The DFCM will obtain and pay for all utility connections fees and impact fees.

**C. Re: pg. 238, par. 16 and Pg. 249, par. B.3.**

A contradiction exists between these two paragraphs regarding the provision of a distilled water system. Please clarify.

A: Distilled water will be provided by the owner at each lab as needed. Distilled water is (NIC).

**D. Re: pg. 241, Site Utilization Concepts**

It is stated that the site is approximately 500 ft. x 500 ft. This is the equivalent of ~5.74 acres. Are you expecting that the Design-Builder must improve this much area of the campus under this project?

A: Improve only as much site as is needed to complete the design and functionality of the facility.

**E. Re: pg 242, Structural Considerations**

It is stated: The facility will consist of a two-story, 72,000 gsf academic building...

However, the project is programmed for 59,278 gsf. Please clarify.

A: Please see addendum no. 1 item 16 and attachments. Facility is at approximately 60,799 gsf.

**F. Re: pg. 251, par. G5.**

It states: Piping shall be schedule 40 black steel only.

This is inconsistent with the USU Fire Marshal's website which allows Schedule 10 for pipe diameters 4" and larger, Dynaflo for 2.5" – 3" diameters, and Dynathread for 2" and smaller diameters. Will this project only accept schedule 40 black steel pipe for all fire suppression piping?

A: DFCM design standards call for schedule 40 black steel only and it must be domestic pipe.

**G. Re: pg. 253**

It states: All equipment and furniture identified during design, whether it is furnished in this contract or a separate contract, shall be provided with power and raceway rough-in for complete operation. Coordinate furniture connections with furniture systems supplier.

Does "during design" mean prior to the submittal of the Design-Builder's proposal? Also, what is intended by coordination? Does this mean verifying capacity and location? Who is responsible for final hook-up?

A: This is a Design-Build project. Design continues to the completion of the project. Therefore coordination is comprehensive to the project duration. Final hook-up is the Owners responsibility.

**H. Re: pg. 254, Emergency Power Distribution**

It states: It (emergency generator) shall be sized to include standby power for selected areas and equipment as directed by the owner to include but not be limited to: computer systems, telephone equipment, selected refrigeration equipment, selected lab equipment and any other items directed by the owner.

This is very vague; will these items be identified prior to the submittal of the Design-Builder's proposal? Or can a KW rating be provided?

A: Will provide more information at next users meeting.

**J. Re: pg. 255, Security/Access Control System & Voice/Data Communications System**

Will direction on these items be provided prior to the submittal of the Design-Builder's proposal? If not can an allowance be established for these items?

A: Security Control and voice data will be by owner. Access Control System will be in the contract.

**K. Re: Civco Engineering Roadway Plan**

No curb cut(s) is(are) shown on the east side of this street for this campus. How is this to be coordinated, provided, and paid for?

A: There are curb cuts on the east side of the new road. The cost of the one approach into the building is paid for by the road project..

1. Addendum #2 page 253 states: "Each lab shall be served by a dedicated panel". Does this include the smaller labs such as the support open lab (18x22) and natural resources bio-lab 22x20 or just the larger labs? Is there a square foot requirement where the dedicated panel is required for the labs?  
A: Follow the Addendum, each lab has a dedicated panel.
2. Addendum #2 page 253 states: "For groups of 3 or more motors, motor control centers shall be provided." Is this required for all cases and situations? For example, what if there are (3) 1HP motors to be controlled; requiring an MCC will likely drive up the cost and may not provide enough advantage to outweigh the cost.  
A: Follow the addendum instructions.
3. Addendum #2 page 253 states: "All 120V branch circuits serving harmonic producing equipment shall be provided with oversized neutral." Should all receptacles be treated as harmonic producing since

the equipment being used is often unknown and could be produce harmonics.

A: Follow DFCM electrical standards.

4. Should the Bingham building exit signs match those approved and listed in the USU Electrical Design Requirements (page 5)?  
A: No, these signs may be individual and not associated with USU Electrical Design requirements.
5. Should the Bingham building exterior lights match those approved and listed in the USU Electrical Design Requirements (page 5)? If so, which one?  
A: No DFCM Guidelines.
6. Confirm concrete encasement is required for medium voltage RMP feeders? This is required in DFCM Design Requirements 3.6.G.(2) and the USU Electrical Design Requirements.  
A: Follow DFCM Design Requirements.
7. Will fiber service be brought into the building?  
A: Yes it will be in the building, Will be in the contract.
8. Is innerduct required in any of the service or distribution conduits for either fiber service or fiber network?  
A: Same as #7.
9. Is Notifier the only approved fire alarm vendor (USU standard) or is it open to other vendors?  
A: Will be answered at next Users Meeting.
10. Who designs and provides the sound reinforcement systems?  
A: Will be discussed at next users meeting.
11. Will there be any TV distribution, Cable TV service or satellite TV service?  
A: No. Owner will provide
12. Will there be a Clock System included in the design?  
A: No

1.) Is there a defined Project Limit Line for site work and landscaping requirements? This will impact LEED credits.

A: To be determined by the Design Build team.

2.) The Draft DFCM Issue Report on LEED-NC states DFCM's recommendation for projects using the High Performance Building Rating System (HPBRS) and LEED-NC. Since these two systems have similarities, this document provides a reference table of LEED credits that meet the requirements of and may be applied to HPBRS credits. Therefore a project could work towards LEED Certification and separately document only the HPBRS credits not already addressed by their LEED submittal. Can we assume that this hybrid-type approach is allowable for the BEERC project?

A: See addendum No 1 item 5. this approach is allowed but the goal is for LEED Silver.

(Chamonix) This is allowed by DFCM. Please submit a DFCM checklist and indicate on when the team is using LEED to meet the High Performance requirements so DFCM has a record of this.

3.) Is the Distilled Water System to be provided by the facility user as stated on page 238 Paragraph 16 or centralized as stated on page 249 B.2?

A: No, Distilled Water System by owner.

4.) What area/user representatives will be at the February 10<sup>th</sup> & 24<sup>th</sup> breakout meetings for space specific discussions?

A: Dean of Science, Mary Hubbard. Department Head of Biology, Darryl Dewald.

1) Exhaust hoods – Verify quantity of perchloric acid hoods.

A: No (NIC)

2) How will campus deal with maintenance? Will it be a service contract with a Mechanical Contractor or in house?

A: Undecided

3) D.I. water – is this by Owner or in contract.

A: NIC

4) Discuss Mechanical Contractor for our team, any requests by USU?

A: Up to the Design Team.

5) LEED model by whom?

A: Nexant

- 6) Mechanical controls listed in the program are Johnson or Control Systems International, is this correct?  
A: Utah Controls/Yamas
- 7) Verify if PVC piping is allowed on project, program list both acceptable and prohibited.  
A: We have allowed PVC/ABS for underground due to soils conditions. Design team will have to make recommendations.
- 8) What are the laboratory room air temperature and humidity requirements?  
A: To be discussed in next users meeting.
- 9) List room by room equipment heat gain.  
A: Unknown
- 10) Who is USU's water treatment company in Vernal?  
A: Unknown but will provide in next users meeting.
- 11) Program lists BTU metering, is this required where the HVAC system is independent for each building?  
A: Up to the Design Build team.
- 12) Will grooved pipe (Victaulic) be allowed?  
A: Follow DFCM Standards.
- 13) Will fire sprinkler performance specifications be acceptable?  
A: Up to the Design Build Team.
- 14) What date of DFCM design standards will the design team be held to?  
A: The most current posted on DFCM web site.

1. Can the electronic copy of the ALTA and site survey be provided to the design teams?

A: The master plan provided in the Program is the most current site survey. Will try and provide prior to next users meeting.

2. The program talks about providing a dock leveler at the loading dock. Is the dock leveler a mandatory requirement or can a scissor lift be provided in lieu of a dock leveler?

A: A scissor lift will be acceptable.

3. SS-Com (6.14.34) indicates the cabinets and storage shelving are in the contract. The diagram indicates NIC. Please clarify?

A: Storage cabinets are NIC. Storage room Shelving is in Contract

.

4. Please provide the Owner Program Requirements.

A: Unclear as to what the question is asking.

5. Program indicates that card reader and electric strikes are NIC. This creates some difficulty with providing a complete operating door system at turn over. Clarify if this is the correct direction?

A: Included in the contract. All exterior doors and on this system. More information on the next users meeting.

6. Addendum #2 - pg 241 indicates the site is approx. 500' x 500'. The site survey indicates the property boundary is 665' x 900'. Which is correct? Please clarify?  
A: 500' X 500'

7. Addendum #2 - pg 254 - 2nd paragraph indicates MC cables are strictly prohibited. MC cable have been accepted on past DFCM project. Please confirm if this is a mandatory requirement for this project?

A: MC cable is accepted as long as the DFCM installation requirements are met. In fire systems color code requirements are necessary.

1) Can we amend to add commissioning requirements that fall into the contractor/controls contractor arena? We might need to amend the spec's that were provided in the program to accomplish this.

A: Please clarify

2) Can ponds on site be used for landscape irrigation?

A: Yes, but the only pond on site is quite a distance to the east of the building. There is irrigation water at the site that is pressurized. The location of the line and valve is at the north west corner of the UBATC building.

3) When can we meet with Synergy to resolve the OPR (Owner's Project Requirements)

A: Please present specific question to Synergy and Vic Middleton. If needed the questions may be answered as with an addendum.

4) Where does USU want to use the incentive funds (keep for later, try to put in project now)

A: Owner decision, does not need to be addressed at this time.

5) Can USU require owner supplied equipment (like fridges, LCD screens etc.) to be Energy Star rated or equally efficient relative to what is on the market.

A: Energy Star Rated.

## **COMMENTS AND CHANGES TO PROGRAM**

### **Commissioning.**

1. Control contractor well defined. Web based.

2. It is a requirement that the contractor will calibrate any sensors. I.e. c/o sensors photocell sensors.

## **Energy:**

Nexant is the energy modeling consultant with RMP.

Incentive to design to team. To assist the design quantify the savings.

Paid in lump sum to the owner.

RMP commissioning required different from building commissioning.

The Baseline shown by RMP does not take into account for DFCM design standards or LEED criteria.

Lighting in this building could be as much as 50% of energy costs. DFCM requires a 10% reduction in cost savings. You could possibly gain a 27% savings in lighting.

## **Record Drawings.**

Manuals Access.com has a program to bring all information needed for project closeout records. You will be required to use this format or similar to submit to DFCM and Utah State at the completion of the project.

## **Contact**

### **Manuals Access**

PO Box 136

Sandy, UT 84093

Phone: 801-619-2082

Fax: 801-619-1679

[Info@manualsaccess.com](mailto:Info@manualsaccess.com)

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Designed by **Nexus**

## **LEED:**

In your submittals please include a cost breakdown of each credit that will be recommended by your team. Also a cost savings estimate for that credit item should be submitted.

## **UTILITIES:**

There are electrical and gas opportunities servicing the new building coming from the

existing UBATC/USU building.

## **BUILDING SPACE: Changes to the Program.**

1. BC RS 2 in the program indicates it needs to be on the first floor. This is not a requirement
2. Lab layout. Program shows a 24 student lab and also a 16 student lab. The 24 is a maximum but is not intended to change the size of labs.
3. There will be no Perchloric Acid Fume Hood.
4. The building program indicates two elevators. Two elevators will be required in the building. One being a passenger and one being a passenger/freight elevator.
5. Cold room to be built for owner to occupy for their individual needs and units supplied by owner.
6. The program requires recycling waste (construction) at 75%. This will not be a requirement.

## **Fire Suppression and Alarm**

The drawings will be submitted to both State Fire Marshall and USU for review. We will follow the USU Design Standards.

# **USERS MEETING SCHEDULE BINGHAM ENTREPRENEURSHIP & ENGINEERING CENTER UTAH STATE UNIVERSITY DFCM Project # 08273770**

**USERS MEETING'S  
LOCATION: LITTLE AMERICA HOTEL SLC  
TIME ASSIGNMENTS**

**February 10<sup>th</sup> Tuesday Second users meeting**

**7:30am to 10:30am**

**TEAM \_\_\_\_\_ JACOBSEN \_\_\_\_\_**

**11:00am to 2:00pm**

TEAM \_\_\_\_\_ GRAMOLL \_\_\_\_\_

2:30am to 5:30pm

TEAM \_\_\_\_\_ OKLAND \_\_\_\_\_

February 24<sup>th</sup> Tuesday Third users meeting.\

7:30am to 10:30am

TEAM \_\_\_\_\_ OKLAND \_\_\_\_\_

11:00am to 2:00pm

TEAM \_\_\_\_\_ JACOBSEN \_\_\_\_\_

2:30am to 5:30pm

TEAM \_\_\_\_\_ GRAMOLL \_\_\_\_\_

# Bingham Entrepreneurship & Energy Research Center

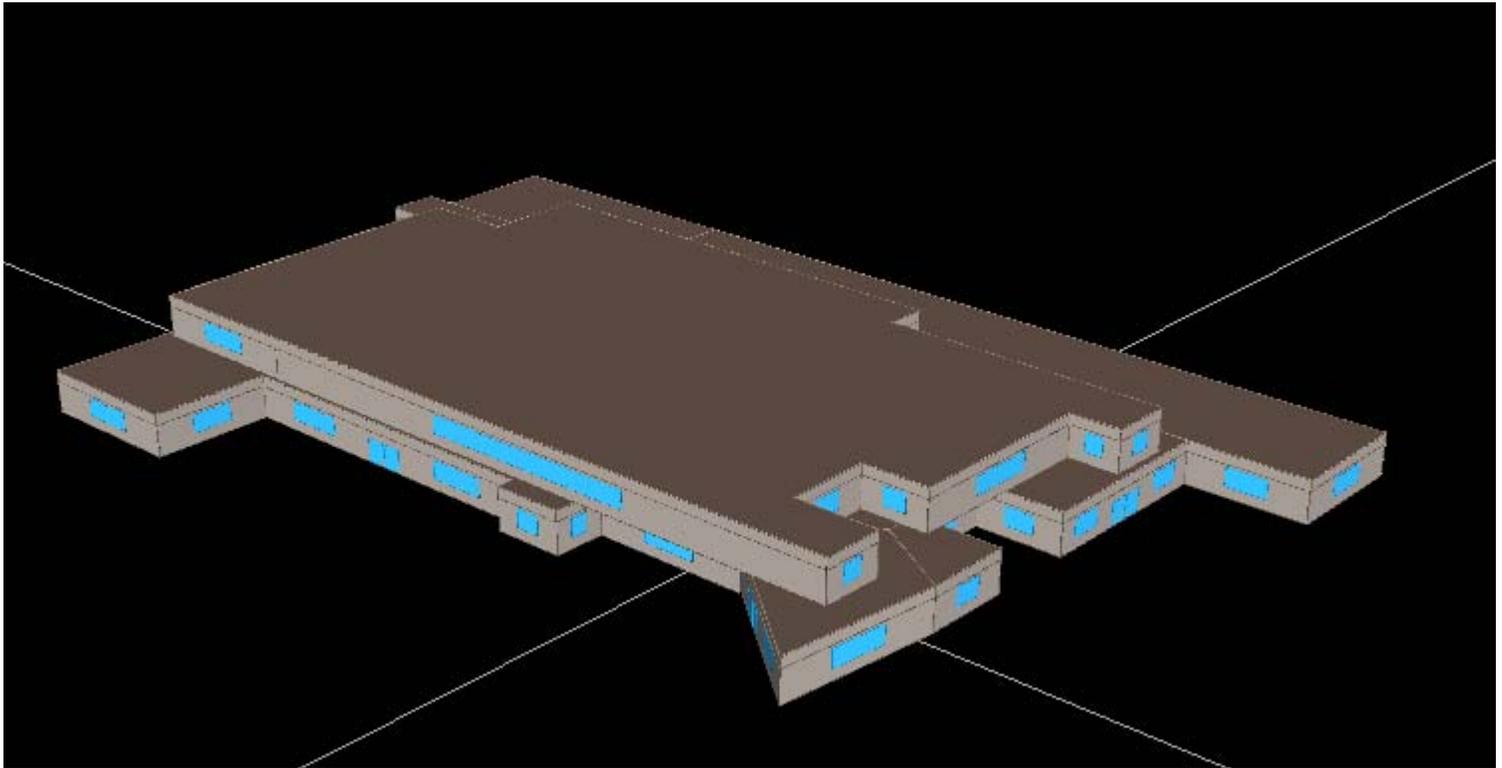
**Energy Efficiency Scoping Study**  
January 20, 2009



# Energy FinAnswer

- ▶ Comprehensive projects – new & retrofit
  - ▶▶ Can include lighting – cap on lighting savings
  - ▶▶ Your lighting projects may be packaged
- ▶ Energy Analysis – study, highest priority
- ▶ Incentive
  - ▶▶ \$0.12/kWh + \$50/kW demand reduction
    - ✓ Incentive caps may apply
  - ▶▶ Commissioning required
  - ▶▶ Payable by one-time lump sum check

# The Facility



# The Facility

- ▶ New 60,800 ft<sup>2</sup> research facility in Vernal, Utah
  - ▶▶ Two-story, brick and stone exterior finish
  - ▶▶ The focus is on:
    - ✓ Research
    - ✓ Teaching
    - ✓ Entrepreneurial business development
  - ▶▶ The facility will house:
    - ✓ Research & Laboratories (approx. 15,600 ft<sup>2</sup>)
    - ✓ Classrooms & Computer Lab (approx. 23,900 ft<sup>2</sup>)
    - ✓ Offices (approx. 5,100 ft<sup>2</sup>)
    - ✓ Mechanical, Electrical & Support (approx. 16,200 ft<sup>2</sup>)

# Vernal, Utah

## Vernal

Winter and Summer Design Conditions

7727 Heating Degree Days, 342 Cooling Degree Days

-11°F Winter Design, 90°F Summer Design

## Salt Lake City

Winter and Summer Design Conditions

5983 Heating Degree Days, 927 Cooling Degree Days

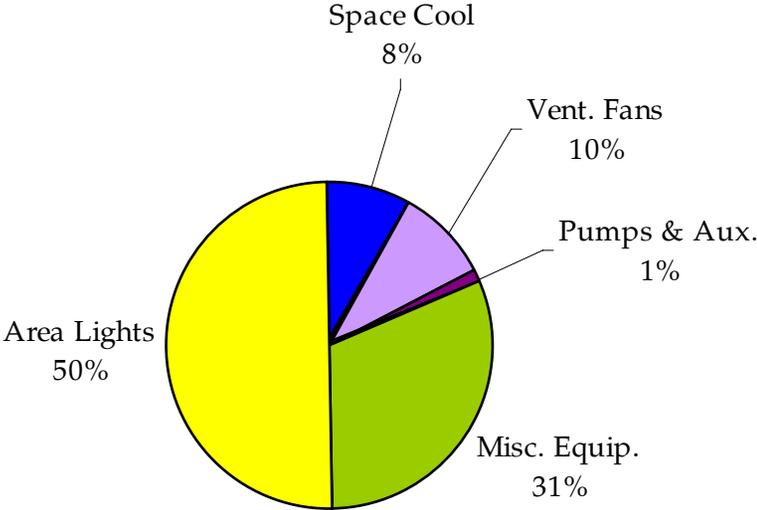
1°F Winter Design, 95°F Summer Design

# Baseline Design

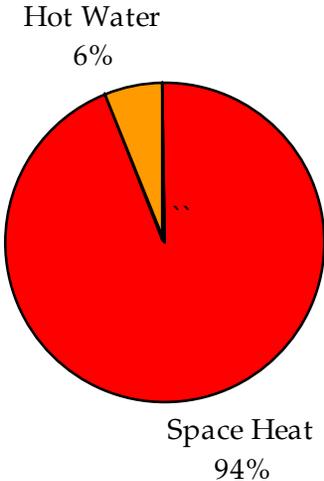
- ▶ Walls: R-13 Insulation
- ▶ Roof: R-30 Insulation
- ▶ Windows: u-value = 0.55, SHGC = 0.40
- ▶ A/C System: Packaged VAV, 9.5 EER
- ▶ Gas Boiler: 80% Efficiency
- ▶ Lighting density: Per code
- ▶ No Daylighting
- ▶ Constant volume fume hoods
- ▶ VAV for office spaces, Constant volume lab spaces

# Baseline Energy Usage

Electricity (kWh) Usage



Gas Usage

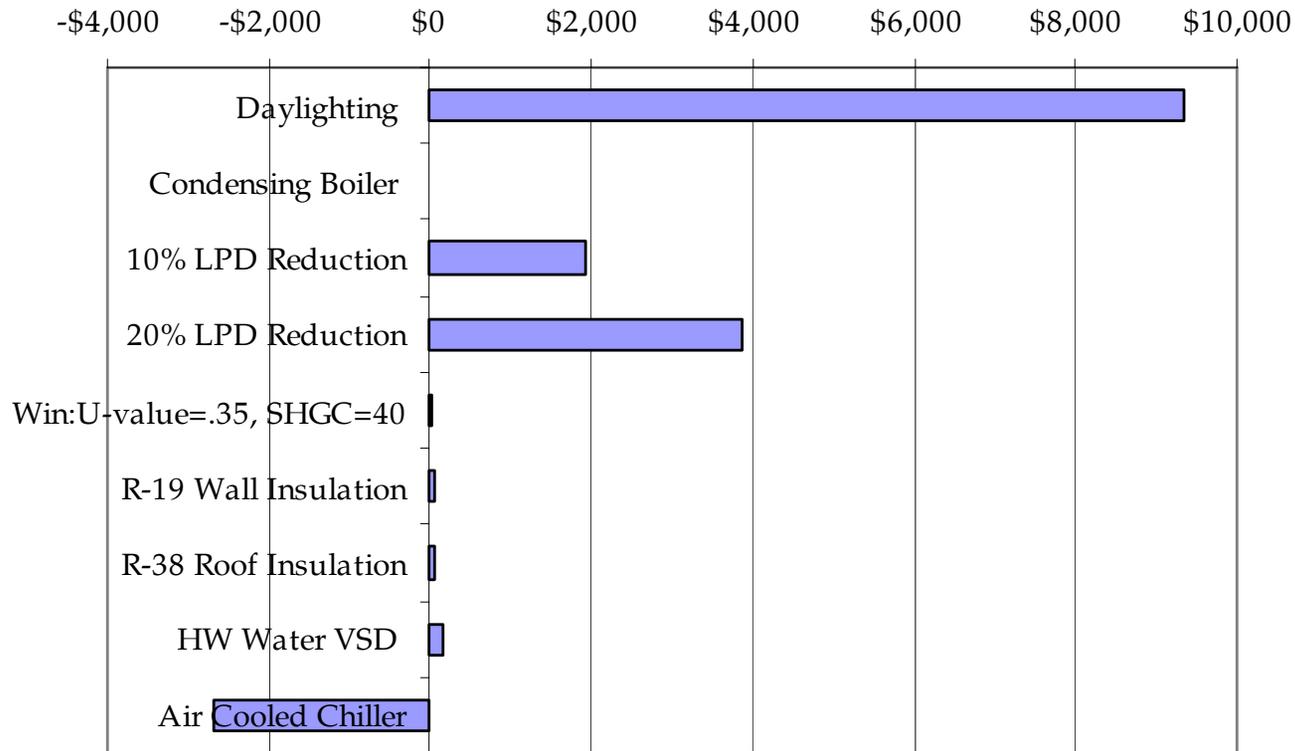


# Proposed Design

- ▶ Improved walls insulation: R-19 Insulation
- ▶ Improve Roof Insulation: R-38 Insulation
- ▶ More Efficient Windows: u-value = 0.35  
SHGC = 0.40
- ▶ Increase A/C System Eff.: Packaged VAV, 9.5 EER
- ▶ Increase Gas Boiler Eff.: 94% Efficiency
- ▶ Reduce Lighting density: 90% of code
- ▶ Explore Using Daylighting controls

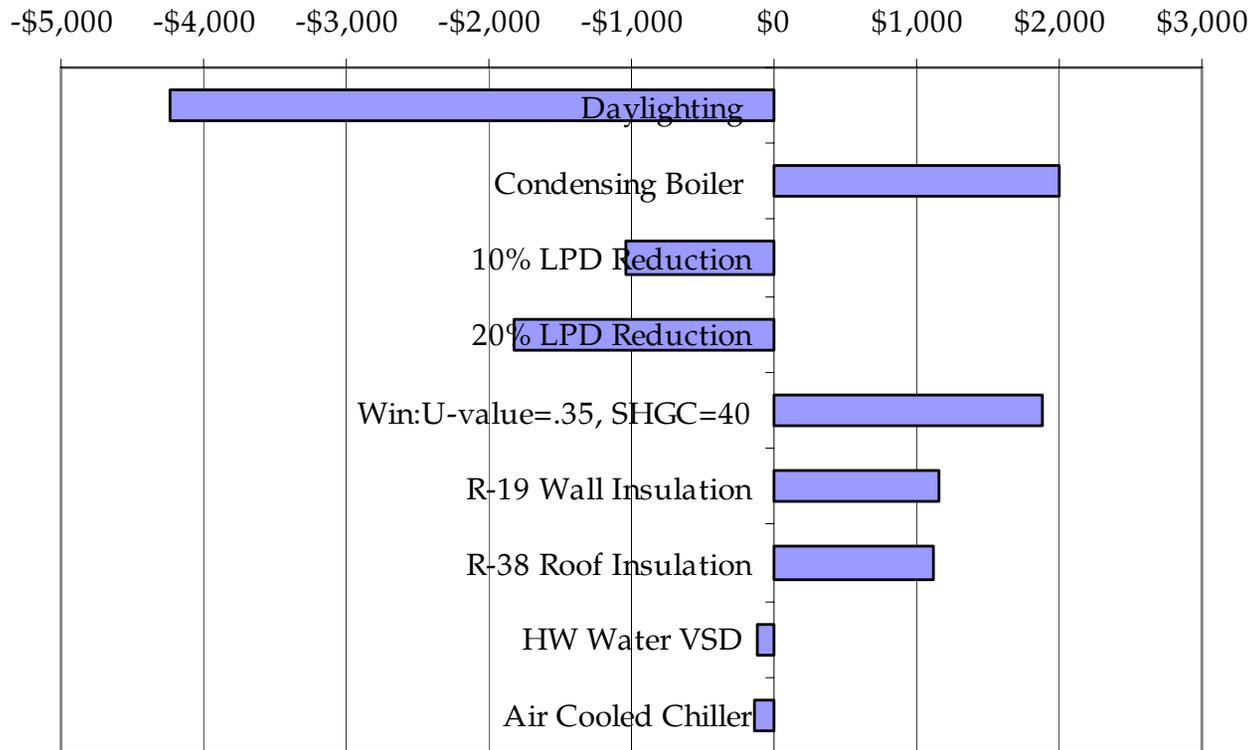
# Electric Savings

Electrical \$ Savings



# Gas Savings

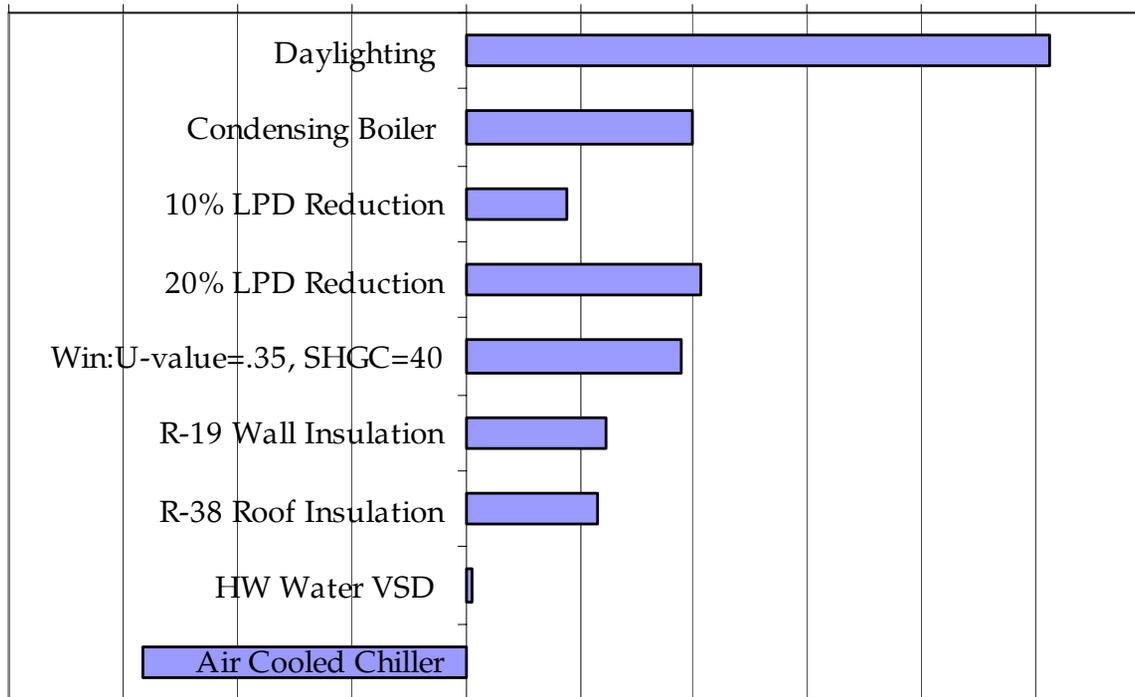
Gas \$ Savings



# Total Savings

Total \$ Savings

-\$4,000 -\$3,000 -\$2,000 -\$1,000 \$0 \$1,000 \$2,000 \$3,000 \$4,000 \$5,000 \$6,000



# Design Considerations

- ▶ Basis of Design
- ▶ Building Orientation
- ▶ System Selection
- ▶ Air Distribution
- ▶ Heating and Cooling
- ▶ Lighting Design
- ▶ Daylighting & Lighting Controls
- ▶ Envelope & Glazing
- ▶ Controls
- ▶ End Uses

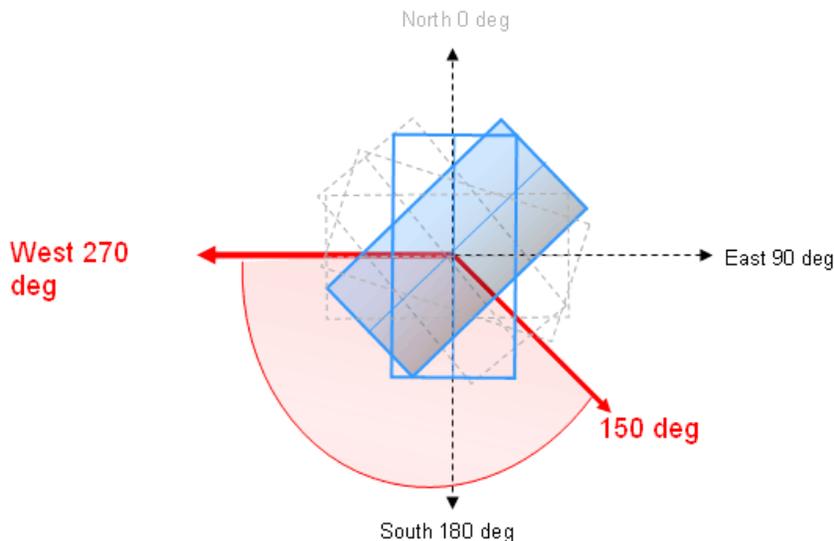
*Not listed in order any particular order*

# Basis of Design

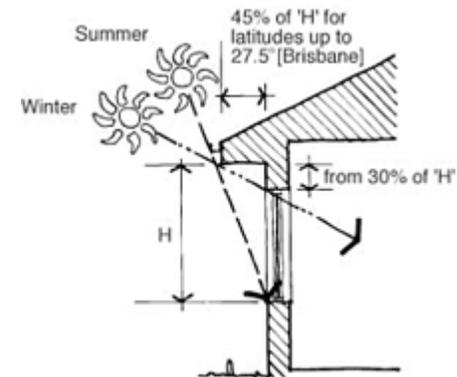
- ▶ Identify:
  - ▶▶ Owner Project Requirements (OPRs)
    - ✓ LEED Silver
    - ✓ DFCM High Performance Rating System
  - ▶▶ Basis of Design (BOD)
  - ▶▶ Various space types and uses
  - ▶▶ Hours of occupancy
    - ✓ Hours of laboratory use (experiments in progress) may differ from that of the classroom and offices
- ▶ What are client and code requirements for:
  - ▶▶ Temperature and Humidity
  - ▶▶ Minimum ventilation rates
  - ▶▶ Air Filtration (HEPA)
  - ▶▶ Laboratory containment (pressurization)

# Building Orientation

- ▶ Orient building to facilitate daylight harvesting and winter heating gains
  - ▶▶ Elongate the building in the east/west direction
  - ▶▶ Provide more windows on the north & south facades
- ▶ East & West Exposures
  - ▶▶ Sun control devices are least effective on these facades
  - ▶▶ Reduce area of glazing and SHGC



Source: Building Industry Research Alliance



Source: Moreton Bay Research Council

# System Selection

- ▶ Select systems that promote operability, maintainability and energy efficiency
- ▶ 3 or 4 individual HVAC systems

## Level 1

- ▶ 1 or 2 Variable Air Volume (VAV) HVAC systems serving classrooms, offices, computer lab and teaching labs

## Level 2

- ▶ One VAV HVAC system to serve offices, grad cubicles, support, work and conference rooms
- ▶ One constant volume HVAC and exhaust system to serve the laboratories (perchloric acid hoods)

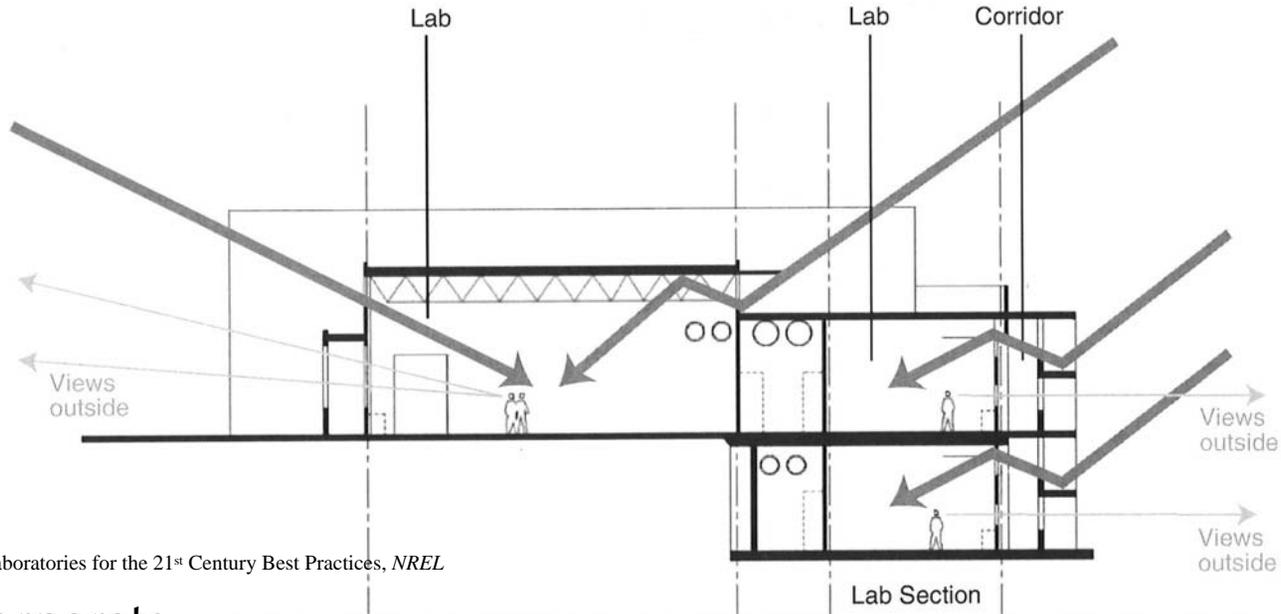
# Heating and Cooling

- ▶ Vernal is a winter heating dominated environment
- ▶ Baseline is rooftop unit. Air cooled chiller and accompanying pumps are more expensive than rooftops.
- ▶ Options
  - ▶▶ Labs to be conditioned using 100% gas fired make-up air units with IDEC cooling (constant volume)
  - ▶▶ Central plant with gas fired boiler to provide heating hot water to heating coils
  - ▶▶ If rooftop units are used, cross-contamination with hood exhaust must be considered.
  - ▶▶ Dedicated CRAC units for server room. Computer classroom can use VAV.

# Lighting Design

- ▶ Interior room surface reflectance
  - ▶▶ Ceilings, minimum 80%
  - ▶▶ Walls and vertical partitions, minimum 70%
- ▶ Options:
  - ▶▶ Reduce lighting power density, at least 10% over code
  - ▶▶ Pendant direct/indirect fixtures
  - ▶▶ Premium efficiency T-8 fixtures
  - ▶▶ Occupancy Sensors

# Daylighting & Lighting Controls



Source: Laboratories for the 21<sup>st</sup> Century Best Practices, *NREL*

- ▶ Incorporate:
  - ▶▶ High continuous daylight windows
  - ▶▶ High ceilings ( $\geq 10'$ )
  - ▶▶ Light shelves, greater daylight penetration and uniformity
  - ▶▶ Clerestories

# Daylighting & Lighting Controls

- ▶ Maximize building glazing orientation (north/south facades)
- ▶ Increase glazing visual light transmission (0.50-0.70) for glazing between 6' AFF and ceiling
- ▶ Consider heat gain and glare consequences
  - ▶▶ Exterior horizontal architectural overhangs
- ▶ Control Types
  - ▶▶ Dimming: minimum 20% of full output, minimizes employee distraction, higher cost
  - ▶▶ Stepped: on/off control, potential problems, lower cost
- ▶ Calibration and commissioning
  - ▶▶ Proper photocell placement is mandatory
  - ▶▶ Calibrate after furniture is in place and prior to occupancy

# Envelope and Glazing

- ▶ Walls: R-19 Insulation
- ▶ Roof: R-38 Insulation
- ▶ Windows:  $u\text{-value} = 0.35$ ,  $\text{SHGC} = 0.40$
- ▶ Increase solar heat gain coefficient (winter heating benefit) however provide horizontal overhangs to block high summer sun angles
- ▶ Provide lower window assembly U-values (NFRC rating procedures)

# Controls

- ▶ Provide control strategies that are appropriate and help reduce energy
  - ▶▶ Time of day scheduling (occupancy)
  - ▶▶ Demand Control Ventilation (DCV)
  - ▶▶ Setback temperature strategy
  - ▶▶ Static pressure resets
  - ▶▶ Tie VAV boxes to lighting controls
- ▶ Consider LEED Commissioning and M&V Requirements
  - ▶▶ Will the BAS system support trending and monitoring as required by LEED?
  - ▶▶ BAS vs. point of use trending and monitoring

# End Uses

- ▶ Identify various end uses and corresponding schedules:
  - ▶▶ Offices
  - ▶▶ Classrooms
  - ▶▶ Laboratories
  - ▶▶ Computer Labs
  - ▶▶ Storage Rooms
- ▶ Choose the appropriate number and type of lighting and HVAC systems, and control type that yield a cost effective, operational, effective and maintainable facility.

# Commissioning

- ▶ LEED Fundamental / Enhanced Commissioning
  - ▶▶ starts in the initial phase of design
- ▶ Systematic process of confirming final design meets design intent
- ▶ Verifies that the building's energy related systems are:
  - ▶▶ Installed properly,
  - ▶▶ Calibrated, and
  - ▶▶ Perform according to owner's project requirements
- ▶ Not the same as check, test, and start-up

# Resources

- ▶ Labs 21 - <http://www.labs21century.gov/>
- ▶ US Green Building Council – <http://www.usgbc.org/>
- ▶ Advanced Energy Design Guide for Small Office Buildings (ASHRAE Special Project 102)
- ▶ Ventilation for Acceptable Indoor Air Quality
  - ▶▶ ASHRAE Standard 62
- ▶ The Commissioning Process –
  - ▶▶ ASHRAE Guideline 1-1996
  - ▶▶ ASHRAE Guideline 0-2005

# For More Information

- ▶ DFCM
  - ▶▶ Chamonix Larsen, 801.550.2341
- ▶ Rocky Mountain Power
  - ▶▶ Chris Kanoff, 503.813.5122
- ▶ Nexant
  - ▶▶ Kirk Moushegian, 801.464.2256
  - ▶▶ Matt Gibbs, 801.464.2241

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