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2018

LANL: Net Zero Campus Using Modular Construction

FEASIBILITY STUDY

ADAM COLLINS

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Introduction

Since its creation, Los Alamos National Laboratory has been a mission driven facility. One goal, of many, is to enable mission delivery through next-generation facilities, infrastructure, and operational excellence. That goal is fostered through the creation of a modern, environmentally responsible workplace. With this drive towards environmental stewardship, there has been an increase in the not only the design of high performing sustainable buildings, but in the use of sustainable construction practices as well. To maintain the current environment, projects have begun to use modular construction. While the practice may offer a multitude of benefits, the high cost of building energy consumption remains. This study stands as an attempt to offer a solution to that problem. With the future creation of a 10 Mega-Watt Photovoltaic System as well as the shift towards modular construction, it may be feasible to generate a *Zero Energy Campus* whose energy consumption zeros out and environmental footprint remains minimal.

Methodology

To determine if Modular Construction can be used to create a *Zero Energy Campus,* TRANE Trace 700 was utilized. TRANE Trace 700 is a building energy simulation software that can help compare the energy impact of a building. It combines the effects of the architectural features, Heating, Ventilation, and Air Conditioning (HVAC) systems, HVAC equipment, and building utilization to create an energy consumption baseline. This building energy simulation software is used within the Engineering Services department of LANL to verify ASHRAE Standard 90.1 and ASHRAE 62.1 standards. The software within this study determines an energy baseline for the general office building at Los Alamos National Laboratory. These requirements are based off the Requirements and Criteria Document (RCD) Number: RCD-03-2634-232 as well as the accompanying conceptual floor plans. Seventy percent of that baseline—as a requirement to ASHRAE High Performing Building Standards— is compared to *Zero Energy Building* case studies to determine the viability of a Modular *Zero Energy Building* and, as a result, a *Zero Energy Campus* with the use of a 10 Mega-Watt Photovoltaic System.

Definitions

This section summarizes necessary definitions for the paper. Definitions will be italicized while used in the paper where necessary.

Annual: Covering at least one period of 12 consecutive months for all energy measurements (U.S. Department of Energy, 2015).

Building: A structure wholly or partially enclosed within exterior walls, or within exterior and party walls, and a roof providing services and affording shelter to persons, animals or property (U.S. Department of Energy, 2015).

Building Site: Building and the area on which a building is located where energy is used and produced. (U.S. Department of Energy, 2015).

Building Energy: Energy consumed at the building site as measured at the site boundary. At minimum, this includes heating, cooling, ventilation, domestic hot water, indoor and outdoor lighting, plug loads, process energy, elevators and conveying systems, and intra-building transportation systems (U.S. Department of Energy, 2015).

Campus: A group of building sites in a specific locality that contain renewable energy production systems owned by a given institution (U.S. Department of Energy, 2015).

Delivered energy: Any type of energy that could be bought or sold for use as building energy, including electricity, steam, hot water or chilled water, natural gas, biogas, landfill gas, coal, coke, propane, petroleum and its derivatives, residual fuel oil, alcohol based fuels, wood, biomass and any other material consumed as fuel (U.S. Department of Energy, 2015).

Exported Energy: On-site renewable energy supplied through the site boundary and used outside the site boundary (U.S. Department of Energy, 2015).

Modular Building: Modular buildings are a set of modules that are built in an off- site fabrication center, delivered to the construction site, assembled, and placed on the permanent foundation (Kamali, 2016).

Modular Construction: Items are assembled in factory environments to form fully finished modules. Whole buildings are formed by a number of modules (Kamali, 2016).

On-site Renewable Energy: Includes any renewable energy collected and generated within the site boundary that is used for building energy and the excess renewable energy could be exported outside the site boundary. The renewable energy certificates (RECs) associated with the renewable energy must be retained or retired by the building owner/lessee to be claimed as renewable energy (U.S. Department of Energy).

Portfolio: A collection of building sites that contains renewable energy production systems owned/leased by a single entity (U.S. Department of Energy, 2015).

Renewable Energy Certificate (REC): Represents and conveys the environmental, social and other non-power qualities of one megawatt-hour of renewable electricity generation and can be sold separately from the underlying physical electricity associated with a renewable-based generation source (U.S. Department of Energy, 2015).

Site Boundary: Line that marks the limits of the building site(s) across which delivered energy and exported energy are measured (U.S. Department of Energy, 2015).

Site Energy: Same as building energy (U.S. Department of Energy, 2015).

Source Energy: Site energy plus the energy consumed in the extraction, processing and transport of primary fuels such as coal, oil and natural gas; energy losses in thermal combustion in power generation plants; and energy losses in transmission and distribution to the building site (U.S. Department of Energy, 2015).

Zero Energy Building: And energy-efficient *building* where, on a *source energy* basis, the actual *annual delivered energy* is less than or equal to the on-site renewable *exported energy* (U.S. Department of Energy, 2015).

Zero Energy Campus: And energy-efficient *campus* where, on a *source energy* basis, the actual *annual delivered energy* is less than or equal to the on-site renewable *exported energy* (U.S. Department of Energy, 2015).

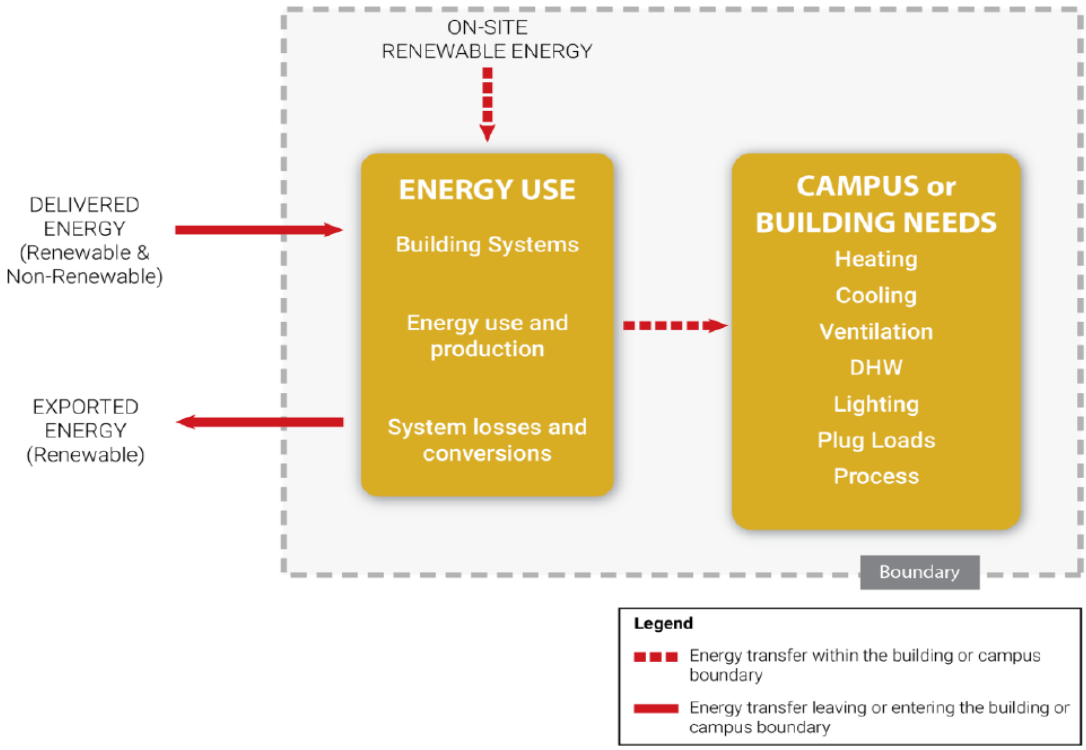
Background Information

Zero Energy Buildings and Campuses

The most important concept to take into account when designing a *ZEB* comes from understanding the definitions behind them. Specifically, the most important concept happens to be the *site boundary*. The *site boundary* generally encompasses the building footprint and the *on-site renewable energy*. For Los Alamos National Lab, the problem with solely utilizing the *ZEB* profile comes from the production of that *on-site renewable energy*. In fact, that renewable energy must be on the site. If the renewable energy comes from a location other than the building site, then there will be a problem with classifying it as a ZEB. The solution is stands to be what is instead called a *ZEB Campus*.

Net zero efforts for a *ZEB Campus* begin with the campus boundary. In identifying the federal campus boundary, a set understanding can be made. According to the Pacific Northwest National Laboratory, the basic building boundary could include energy use, on-site renewable energy production, energy storage, delivered energy, and exported energy as shown in the figure below.

Figure 1 – Conceptual depiction of site boundary for energy balance

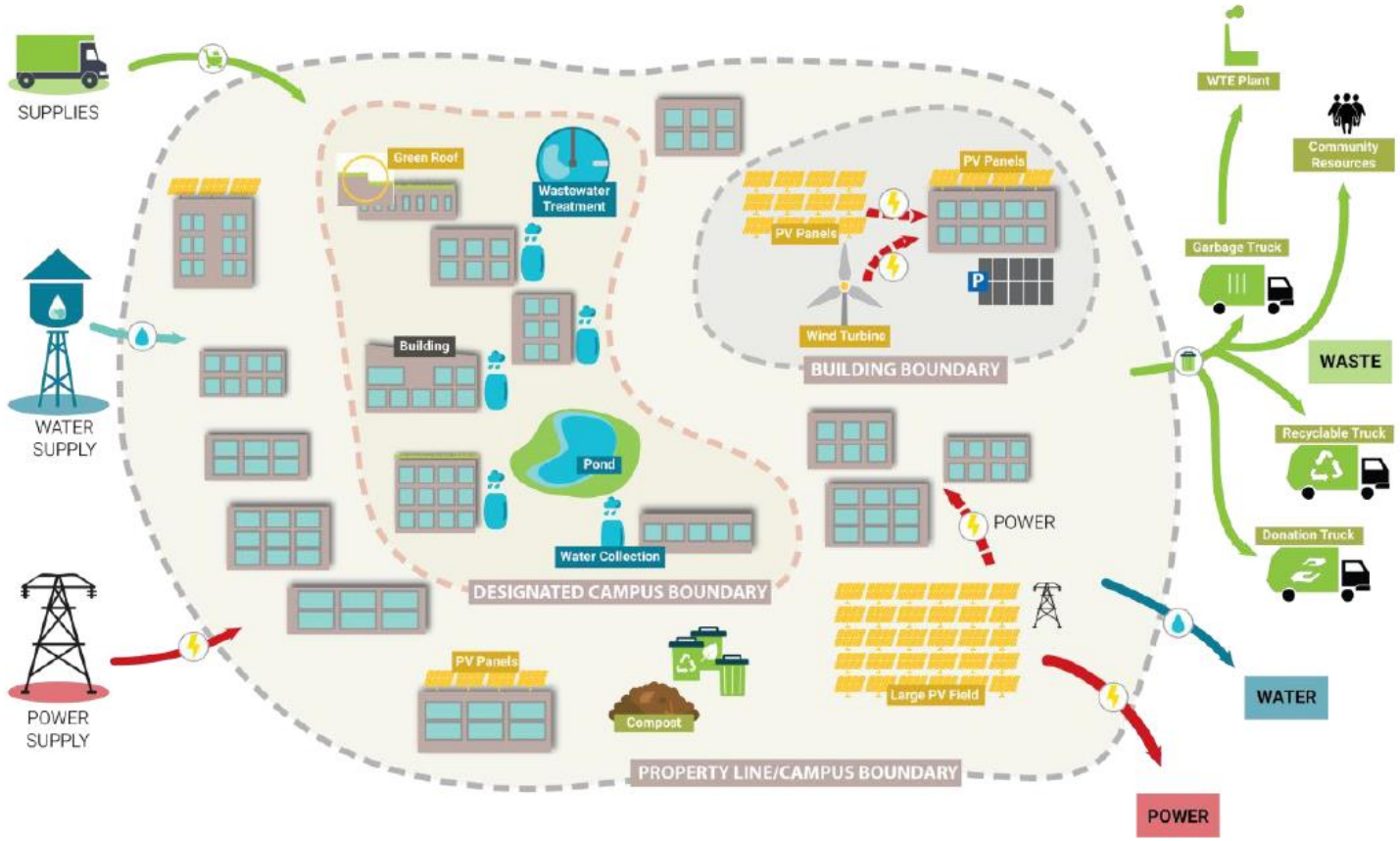


Retrieved from the "Federal Campuses Handbook for Net Zero Energy, Water, and Waste." (2017)

While the basic building boundary doesn't necessary apply in this case, the illustration still develops an overview of the basic boundary. Exported Energy and delivered energy will always be **outside** of the boundary while the *on-site renewable energy* will always be **within** the boundary.

For federal campuses specifically, the Pacific Northwest National Laboratory recommends that agencies consider the best application to implementing the net zero energy for their particular campus; in other words, agencies have the ability to determine the best boundary that aligns with their net zero project. Take the example below:

Figure 2 – Net Zero Boundary Examples



Retrieved from the "Federal Campuses Handbook for Net Zero Energy, Water, and Waste." (2017)

The "designated campus boundary" on this example represents a net zero water campus. Similar to a net zero energy campus, everything encompassed within the boundary are the buildings and the building needs. There are six buildings inside of that boundary because the agency chose to count all six of those buildings to meet the net zero target for its existing buildings. These buildings accumulated together classify as a group. Within a group—it is most important to note—there are no set requirements. That is to say, more specifically, these groups **and** their boundaries are created with complete control. According to the official guidance of FEMP, as directed by CEQ, it was critical that the campus boundary definition allow the most flexibility:

"…there is no specific minimum or requirements around what can or cannot be part of a boundary, so long as it's contiguous. An Agency can set whatever they want as a boundary so long as it's within their own campus property line."

For LANL's sake, this definition creates a world of value. It really means that there is some sort of viability to create a net zero campus within its bounds. The solidification of that viability, however, is dependent upon the type of buildings **and** the source energy calculations within the specific boundaries designated by LANL in the future.

While most site managers are familiar with site energy consumption, it is not useful for demonstrating resource consumption and the emissions associated with the specific energy use; Site energy is better for understanding the performance of a building. In understanding so, the Zero Energy Building definition uses national average ratios to convert different energies into equivalent units of raw fuel consumed. These factors, as seen below, are from the ASHRAE 105 Standard.

Table 1 – National Average Source Energy Conversion Factors

Energy Form	Source Energy Conversion Factor (r)
Imported Electricity	3.15
Exported Renewable Electricity	3.15
Natural Gas	1.09
Fuel Oil (1,2,4,5,6,Diesel, Kerosene)	1.19
Propane & Liquid Propane	1.15
Steam	1.45
Hot Water	1.35
Chilled Water	1.04
Coal or Other	1.05

Retrieved from the "A Common Definition for Zero Energy Buildings." (2015, September)

With these conversion factors, the source energy for a building is calculated via the following formula:

$$E_{source} = \sum_i (E_{del,i} * r_{del,i}) - \sum_i (E_{exp,i} * r_{exp,i})$$

Where $E_{del,I}$ is the delivered energy for energy type *i*; $E_{exp,I}$ is the exported on-site renewable energy for energy type *I*; $r_{del,I}$ is the source energy conversion factor for $E_{del,I}$; and $r_{exp,I}$ is the source energy conversion factor for $E_{exp,I}$.

An example calculation is provided below for a more clear understanding.

Figure 3 – Example Source Energy Calculation

Example Calculation for ZEB with Combined Heat and Power (CHP)

A *building* with CHP has the following actual *annual delivered energy* types: 120,000 kBtu electricity and 260,000 kBtu natural gas. The on-site renewable *exported energy* is 210,000 kBtu electricity from photovoltaics.

Using the formula above, the *annual source energy* balance would be:

$$E_{source} = [(120{,}000\ kBtu \times 3.15) + (260{,}000\ kBtu \times 1.09)] - (210{,}000\ kBtu \times 3.15)$$

$$= 661{,}400\ kBtu - 661{,}500\ kBtu$$

$$= -100\ kBtu$$

Since $E_{source} \leq 0$, the building would be a *Zero Energy Building*.

Retrieved from the "A Common Definition for Zero Energy Buildings." (2015, September)

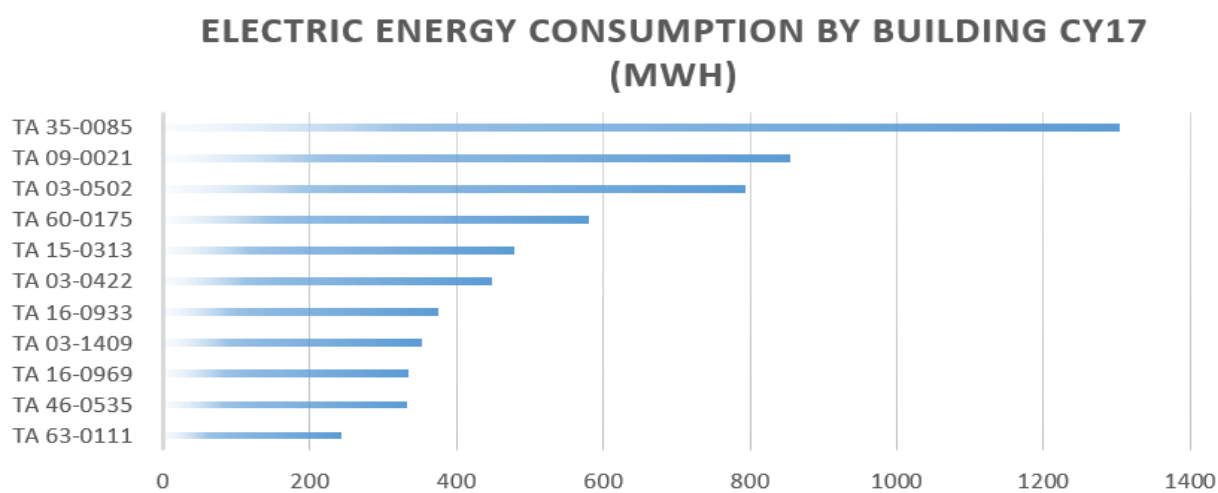
Taking these calculations and applying them specifically to LANL facilities is where problems occur.

Appendix A, as an example, shows the Electric Metering Report for TA 16-0969. In CY17, this facility consumed 335 Mega-Watt hours (MWh) of electricity. The kilo-British thermal unit (kBtu) equivalent is 1,143,067 kBtu.

Following the calculation above, $E_{source} = (1{,}143{,}067 kBtu\ x\ 3.15) - (0) = 3{,}429{,}201 kBtu$ for TA 16-0969. Since $E_{source} \geq 0$, the building would not be a *Zero Energy Building* as it stands.

The important thing to emphasize within this calculation is the magnitude of the source energy required to power this building. TA 16-0969 is only one of many buildings within LANL that consume this capacity of energy on a yearly basis. Even more, TA 16-0969 stands at the lower end of the consumption spectrum for buildings between 19,000 and 26,000 sq.ft. (See Figure 4).

Figure 4 – Electric Energy Consumption by building CY17



Retrieved from the Utilities and Infrastructure Division Metering Data. (2018, April)

With this information in mind, an attempt to create a *Zero Energy Campus* with the current infrastructure would require not only a shift in energy consumption, but also the creation of a renewable resource that would be able to generate energy at this magnitude.

As an example, for this building only, the average photovoltaic system would need to be sized, at the very minimum, 200 kW in Los Alamos, NM. (See Appendix B) Ramping up that size to the proposed 10 MW system would produce enough energy for about 50 of these buildings. While that number does seem high, it would only be wasting the system capability. The strategic idea would be to plan future infrastructures for these *Zero Energy Campuses*. Instead of attempting to zero out the consumption of research facilities, production sites, and large laboratories, focus on the lowest consuming sector—office buildings. More specifically, think of Modular Office Buildings.

Modular Construction

Benefits of Modular Construction
Reduced costs
Less environmental impacts
Better quality assurance
Faster completion time
Requires less space

Modular or prefabricated construction has gradually replaced traditional on-site construction methods for a multitude of reasons. (Generalova, 2016) Otherwise, known as prefabrication or pre-assembly, modular construction combines rapid construction principles with various technologies to develop building systems and frames that can be produced offsite and assembled onsite. Specifically for LANL, this type of construction offers savings beyond general construction costs. By outsourcing the design and construction, this type of system will be able to generate faster completion times and produce less restrictions with on-site assembly—especially with the lack of space LANL currently has within areas that need more office space like TA 03.

For that very reason, LANL has begun to develop projects for modular offices and laboratories. In combining the need for sustainable design via a *Zero Energy Campus* and the future construction of modular buildings, a feasibility study has been created to determine the two's viability within LANL.

Feasibility Study Analysis

Appendix C lists all of the assumptions made within this study. It ranges from the specific rooms and their loads all the way to the building systems. The baseline simulation took U-Factor and construction standards from ANSI/ASHRAE/IES STANDARD 90.1-2016. The systems were sized according to previous LANL Energy data and with the assistance of a subject matter expert. Within the assumptions, anything labeled "to be calculated" is calculated via TRANE Trace 700 and can be found in Appendix E, the Baseline Report.

The simulation noted that the baseline energy consumption for this type of building would equate to **57.898 kBtu/sq.ft/yr**. After multiplying this number by 70%, the High Performing Sustainable Building Baseline would be **40.528 kBtu/sq.ft/yr**.

In comparing the latter number to the case studies in Table 2, creating a *Zero Energy Building* of this type seems very feasible. The average reduction from the baseline to create a *Zero Energy Building* is 54% below the baseline. That, in turn, makes the average energy consumption per square foot to be 23 kBtu/sq.ft/yr. If the baseline above, 57.898 kBtu/sq.ft/yr is multiplied by 54%, that gives a 31.265 kBtu/sq.ft/yr. Given that the reduction from the baseline varies by building, it is very possible to create a *Zero Energy Building* of this type.

Table 2 – Net Zero Case Studies and PV Use

Net Zero Case Studies and PV Use							
Structure Name	Location	Notes	Reduction from baseline ASHRAE 90.1 - 2007	Square Footage	kBtu/yr	kBtu/hr	kBtu/SF/yr
DPR Phoenix Regional Office	Phoenix, AZ	110% renewable production % of energy use	45%	16,533	429,858	49	26
West Berkeley Branch Public Library	Berkeley, CA	110% renewable production % of energy use	62%	9,399	225,576	26	24
Sacred Heart Lower and Middle School Library	Atherton, CA	199% renewable production % of energy use	73%	6,300	107,100	12	17
IDeAs Z2 Design Facility	San Jose, CA	103% renewable production % of energy use	45%	7,200	158,400	18	22
Packard Foundation Headquarters	Los Altos, CA	119% renewable production % of energy use	49%	50,956	1,222,944	140	24
DPR San Francisco	San Francisco, CA	113% renewable production % of energy use	52%	20,010	460,230	53	23
		Average:	54%			Average:	23

Retrieved from "Living Building Challenge Case Studies." (2018, April 20)

References

Generalova, E., Generalov, V., & Kuznetsova, A. (2016) *Modular buildings in modern construction*. Retrieved from www.sciencedirect.com

International Living Future Institute. (2018, April 20) *Living Building Challenge Case Studies*. Retrieved from www.living-future.org/lbc/case-studies/?certs=zero-energy

Kamali, M., Hewage, K. (2016, May 26) *Life cycle performance of modular buildings: A critical review*. Retrieved from www.sciencedirect.com

National Renewable Energy Laboratory. *PVWatts Calculator*. Retrieved from https://pvwatts.nrel.gov/pvwatts.php

RCD No.: RCD-03-2634-232.

U.S. Department of Energy, Pacific Northwest National Laboratory. (2017, August) *Federal Campuses Handbook for Net Zero Energy, Water, and Waste.*

U.S. Department of Energy, The National Institute of Building Sciences. (2015, September) *A Common Definition for Zero Energy Buildings*.

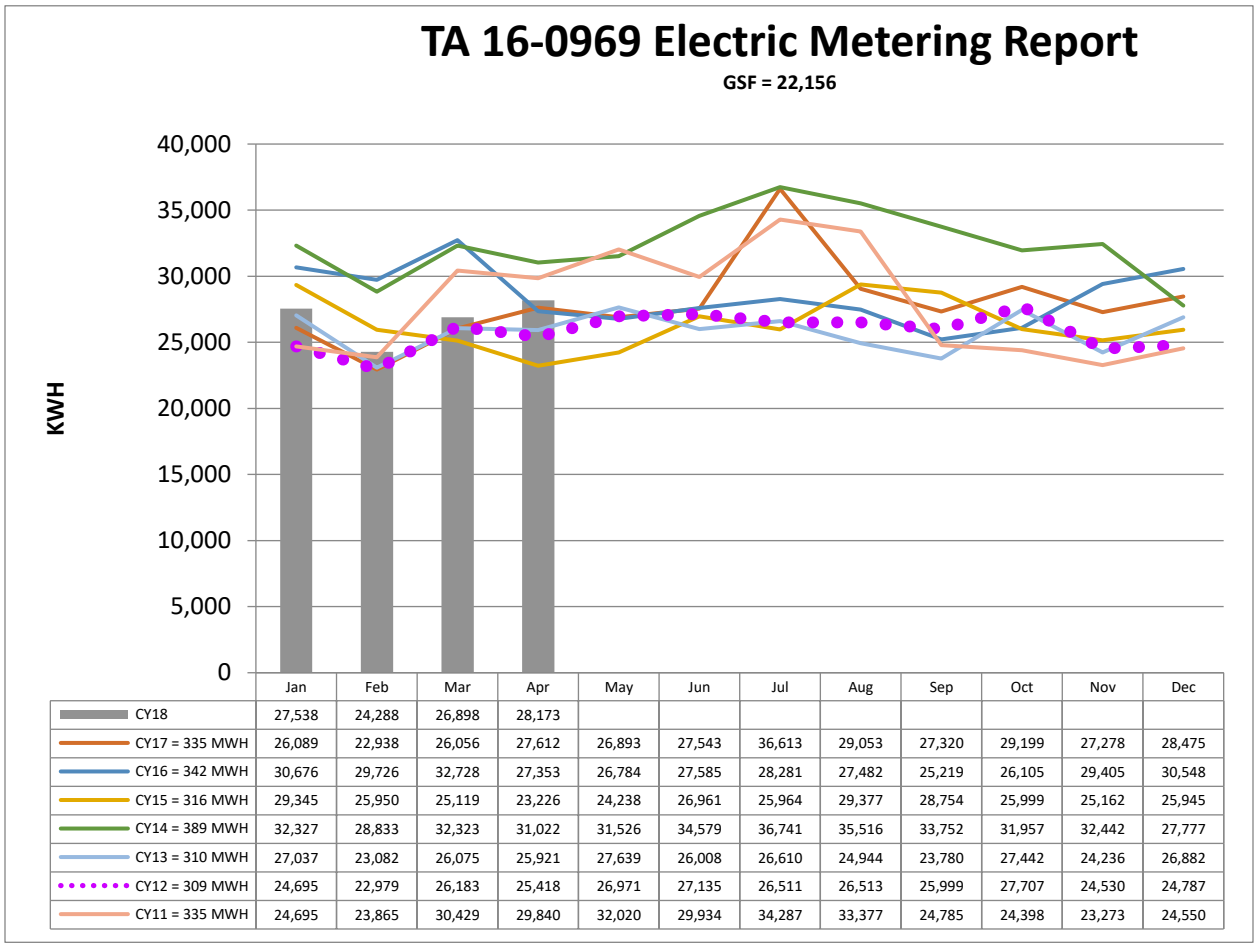
Standards

ANSI/ASHRAE/IES STANDARD 90.1-2016

ASHRAE Handbook: Fundamentals: I-P Edition-2017

Appendices

Appendix A: TA 16-0969 Electric Metering



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
CY18	27,538	24,288	26,898	28,173								
CY17 = 335 MWH	26,089	22,938	26,056	27,612	26,893	27,543	36,613	29,053	27,320	29,199	27,278	28,475
CY16 = 342 MWH	30,676	29,726	32,728	27,353	26,784	27,585	28,281	27,482	25,219	26,105	29,405	30,548
CY15 = 316 MWH	29,345	25,950	25,119	23,226	24,238	26,961	25,964	29,377	28,754	25,999	25,162	25,945
CY14 = 389 MWH	32,327	28,833	32,323	31,022	31,526	34,579	36,741	35,516	33,752	31,957	32,442	27,777
CY13 = 310 MWH	27,037	23,082	26,075	25,921	27,639	26,008	26,610	24,944	23,780	27,442	24,236	26,882
CY12 = 309 MWH	24,695	22,979	26,183	25,418	26,971	27,135	26,511	26,513	25,999	27,707	24,530	24,787
CY11 = 335 MWH	24,695	23,865	30,429	29,840	32,020	29,934	34,287	33,377	24,785	24,398	23,273	24,550

Appendix B: PV System Sizing for TA 16-0969

NREL
NATIONAL RENEWABLE ENERGY LABORATORY

Caution: Photovoltaic system performance predictions calculated by PVWatts® include many inherent assumptions and uncertainties and do not reflect variations between PV technologies nor site-specific characteristics except as represented by PVWatts® inputs. For example, PV modules with better performance are not differentiated within PVWatts® from lesser performing modules. Both NREL and private companies provide more sophisticated PV modeling tools (such as the System Advisor Model at https://sam.nrel.gov) that allow for more precise and complex modeling of PV systems.

The expected range is based on 30 years of actual weather data at the given location and is intended to provide an indication of the variation you might see. For more information, please refer to this NREL report: The Error Report.

Disclaimer: The PVWatts® Model ("Model") is provided by the National Renewable Energy Laboratory ("NREL"), which is operated by the Alliance for Sustainable Energy, LLC ("Alliance") for the U.S. Department Of Energy ("DOE") and may be used for any purpose whatsoever.

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The energy output range is based on analysis of 30 years of historical weather data for nearby , and is intended to provide an indication of the possible interannual variability in generation for a Fixed (open rack) PV system at this location.

RESULTS

339,368 kWh/Year*

System output may range from 319,583 to 350,126 kWh per year near this location.

Month	Solar Radiation (kWh / m^2 / day)	AC Energy (kWh)	Value ($)
January	4.67	23,251	2,111
February	5.48	24,972	2,267
March	6.56	31,764	2,884
April	6.99	32,381	2,940
May	7.64	35,821	3,253
June	7.51	32,917	2,989
July	6.40	28,359	2,575
August	6.29	27,747	2,519
September	6.31	27,640	2,510
October	5.77	27,803	2,525
November	5.11	24,175	2,195
December	4.49	22,538	2,046
Annual	6.10	339,368	$ 30,814

Location and Station Identification

Requested Location	Los alamos, NM
Weather Data Source	Lat, Lon: 35.89, -106.3 0.7 mi
Latitude	35.89° N
Longitude	106.3° W

PV System Specifications *(Commercial)*

DC System Size	200 kW
Module Type	Standard
Array Type	Fixed (open rack)
Array Tilt	20°
Array Azimuth	180°
System Losses	14.08%
Inverter Efficiency	96%
DC to AC Size Ratio	1.2

Economics

Average Retail Electricity Rate	0.091 $/kWh

Performance Metrics

Capacity Factor	19.4%

Appendix C: TRANE Trace 700 Initial Design Assumptions

C.1: Building Geometry

PROJECT AND LOCATION INFORMATION

Parameter	Input	Source
Project/Building	Multi-Use Office Building	RCD-03-2634-232
Weather Station of Design Day	Alamos AP, NM, USA; WMO: 72	2017 ASHRAE Handbook Fundamentals (IP)
Summer Design Cooling DB/WB	89|60	
Winter Design Heating DB	5	
Total Area	~24,000	RCD-03-2634-232

ROOM INFORMATION

Room Description	Template type	Template Chosen
Break Room	Internal Load	Break Room
	Airflow	Break Room
	Thermostat	Conference Tstat
	Construction	General Construction
Conference Room	Internal Load	Conference Room
	Airflow	Conference Room
	Thermostat	Conference Tstat
	Construction	General Construction
Corridor	Internal Load	Corridor
	Airflow	Corridor
	Thermostat	General Office Space
	Construction	General Construction
Electrical Room	Internal Load	Support Areas
	Airflow	Support Areas
	Thermostat	Support Areas
	Construction	General Construction
Fire Riser Room	Internal Load	Support Areas
	Airflow	Support Areas
	Thermostat	Support Areas
	Construction	General Construction
General Office Space	Internal Load	General Office Space
	Airflow	General Office Space
	Thermostat	General Office Space
	Construction	General Construction
IT/Communications Room	Internal Load	IT and Communications Room
	Airflow	General Office Space
	Thermostat	General Office Space
	Construction	General Construction
Janitor Closet	Internal Load	Support Areas
	Airflow	Support Areas
	Thermostat	Support Areas
	Construction	General Construction
Mechanical Equipment Room	Internal Load	Support Areas
	Airflow	Support Areas
	Thermostat	Support Areas
	Construction	General Construction
Printing/Copying Room	Internal Load	Printing/Copy Room
	Airflow	PrintingCopy Room
	Thermostat	Conference Tstat
	Construction	General Construction
Reception Area	Internal Load	Reception Area
	Airflow	General Office Space
	Thermostat	General Office Space
	Construction	General Construction
Rednet Room	Internal Load	Rednet Room Template
	Airflow	Support Areas
	Thermostat	Support Areas
	Construction	General Construction
Restroom	Internal Load	Restroom
	Airflow	Restroom
	Thermostat	Conference Tstat
	Construction	General Construction

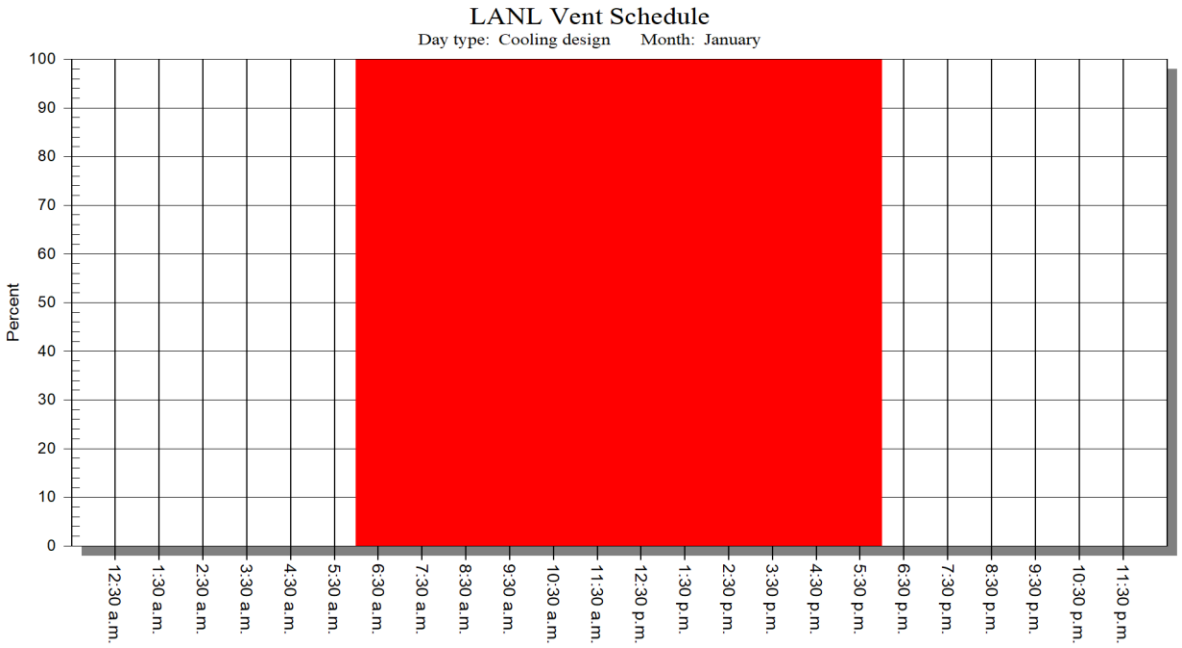
Room	Floor(s)	Area (ft) (LxW)
Office 1	1, 2	12.667x13
Office 2	1, 2	12.667x10.2
Office 3	1, 2	12.667x10.2
Office 4	1, 2	12.667x10.2
Office 5	1, 2	12.667x10.2
Office 6	1, 2	12.667x10.2
Office 7	1, 2	12.667x10.2
Office 8	1, 2	12.667x10.2
Office 9	1, 2	12.667x14
Office 10	1, 2	12.667x14
Office 11	1, 2	12.667x14
Office 12	1, 2	12.667x10.2
Office 13	1, 2	12.667x10.2
Office 14	1, 2	12.667x10.2
Office 15	1, 2	12.667x10.2
Office 16	1, 2	12.667x10.2
Office 17	1, 2	12.667x10.2
Office 18	1, 2	12.667x10.2
Office 19	1, 2	12.667x13
Office 20	1, 2	16x13
Office 21	1, 2	10.91667x12
Office 22	1, 2	11.5x11
Office 23	1, 2	11.5x10.5
Office 24	1, 2	11.5x10.5
Office 25	1, 2	11.5x10.5
Conference Room 1	1, 2	25.5x14
Reception Area	1	19x14
Break Room	1, 2	25.5X14
Office 26	1, 2	11.5x10.5
Office 27	1, 2	11.5x10.5
Office 28	1, 2	11.5x10.5
Office 29	1, 2	11.5x11
Office 30	1, 2	10.91667x12
Office 31	1, 2	16x13
Entrance Vestibule	1	7x28

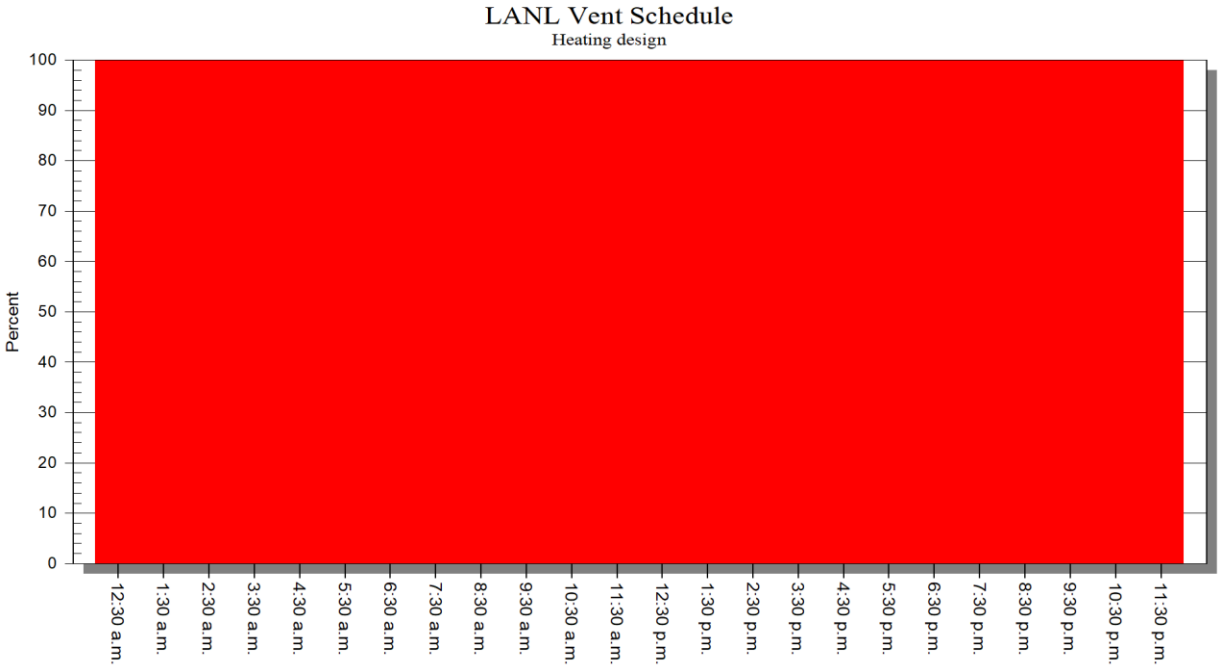
Equipment Room	1, 2	8x9.5
Corridor 1	1, 2	210x7
Corridor 2	1, 2	165.8x7
Conference Room 2	1, 2	23x17.83
Storage Room	1, 2	14x10
Small Mechanical Room	1, 2	14x7.83
Large Mechanical Room	1, 2	23x16.83
Rednet Room	1	11x9
Fire Riser Room	1	9x6.83
Storage Room 2	2	9x6.83
Network Room	2	11x9
Communications Room	1, 2	12x8
Electrical Equipment Room	1, 2	12x9.83
Workspace 1	1, 2	42x12.667
Workspace 2a	1, 2	21x7.83
Printer Area 1	1, 2	7.83x4
Printer Area 2	1, 2	7.83x4
Workspace 2b	1, 2	21x7.83
Workspace 3	1, 2	17.83x7
Janitor Closet	1, 2	7x5
Printer Area 3	1, 2	9x5
Storage Area 2	1, 2	6x5
Mens Restroom	1, 2	21x12.83
Womens Restroom	1, 2	21x12.83
Corridor 3a	1, 2	17.83x8
Corridor 3b	1, 2	17.83x7
Corridor 3c	1, 2	17.83x8
Corridor 3d	1, 2	17.83x7
Corridor 4a	1, 2	10.91667x6
Coridor 4b	1, 2	10.91667x6
North Stairwell	1, 2	20.91667x9.3333
South Stairwell	1, 2	20.91667x9.3333
Office 32	2	11.5x8
Office 33	2	11.5x10
Office 34	2	11.5x10

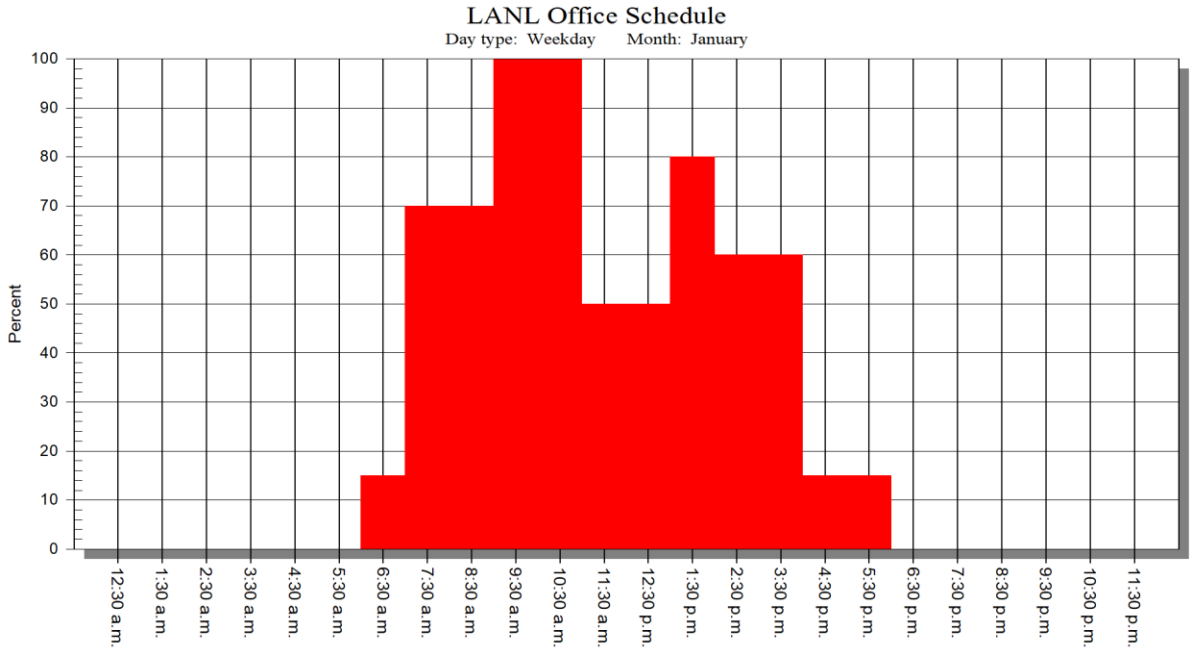
GENERAL CONSTRUCTION TEMPLATE

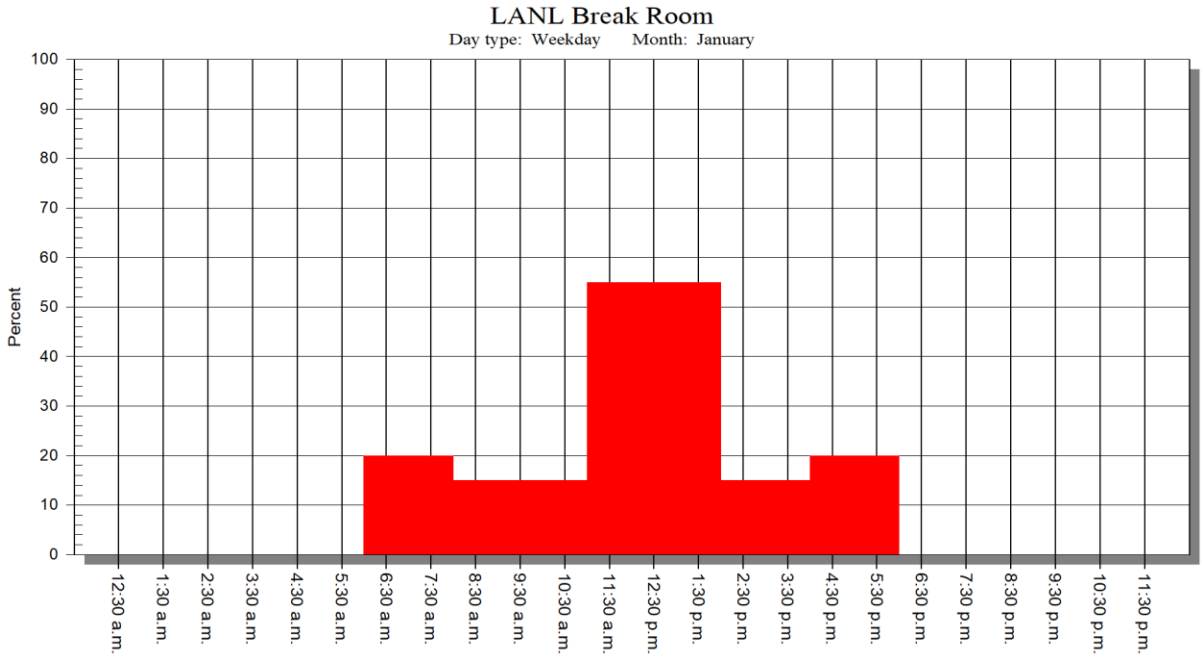
Section	Parameter	Baseline Design	
Construction	Slab	4" LW Concrete	0.212615 U-Factor
	Roof	4" LW Concrete	0.3219 U-Factor
	Wall	Frame Wall, 6" Ins	0.051 U-Factor
	Partition	.75" Gyp Frame	0.387955 U-Factor
Glass Type	Window	6mm Dbl Low-E (e2=.1) Clr	0.6 U-Factor, 0.82 Shading coeff
	Skylight	6mm Dbl Low-E (e2=.1) Clr	0.6 U-Factor, 0.82 Shading coeff
	Door	Standard Door	0.2 U-Factor
Height	Wall	12ft	
	Flr to Flr	12ft	
	Plenum	2ft	
	Pct wall area to underfloor plenum	50%	
	Room Type	Conditioned	

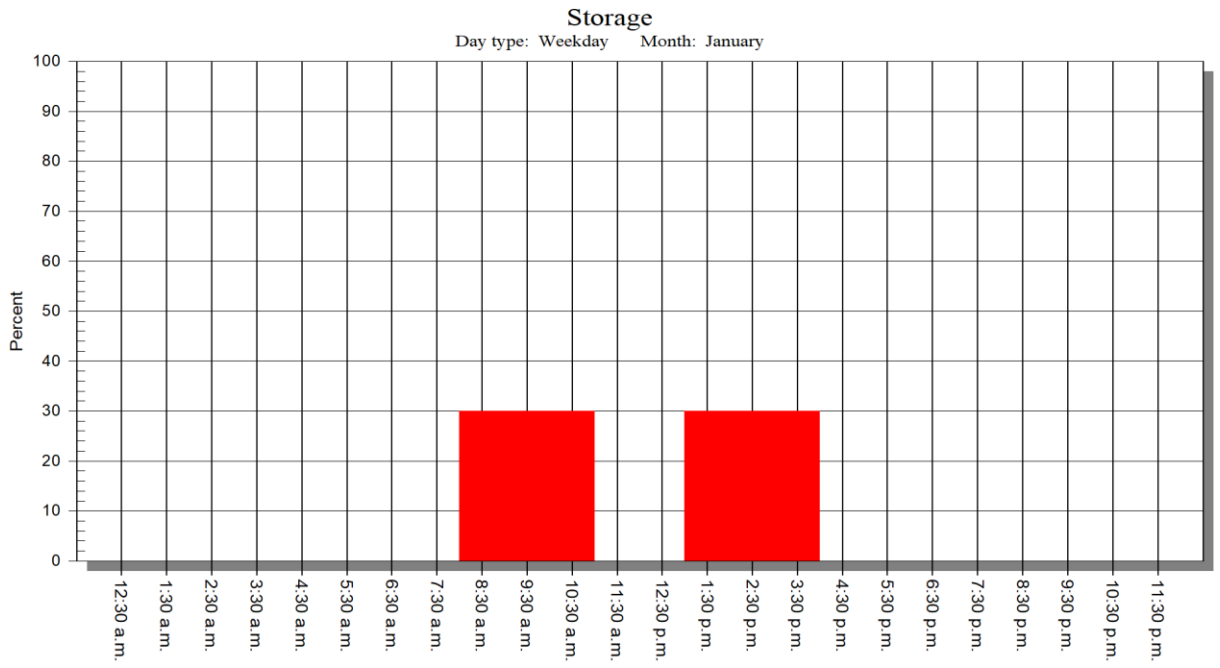
C.2: Schedules

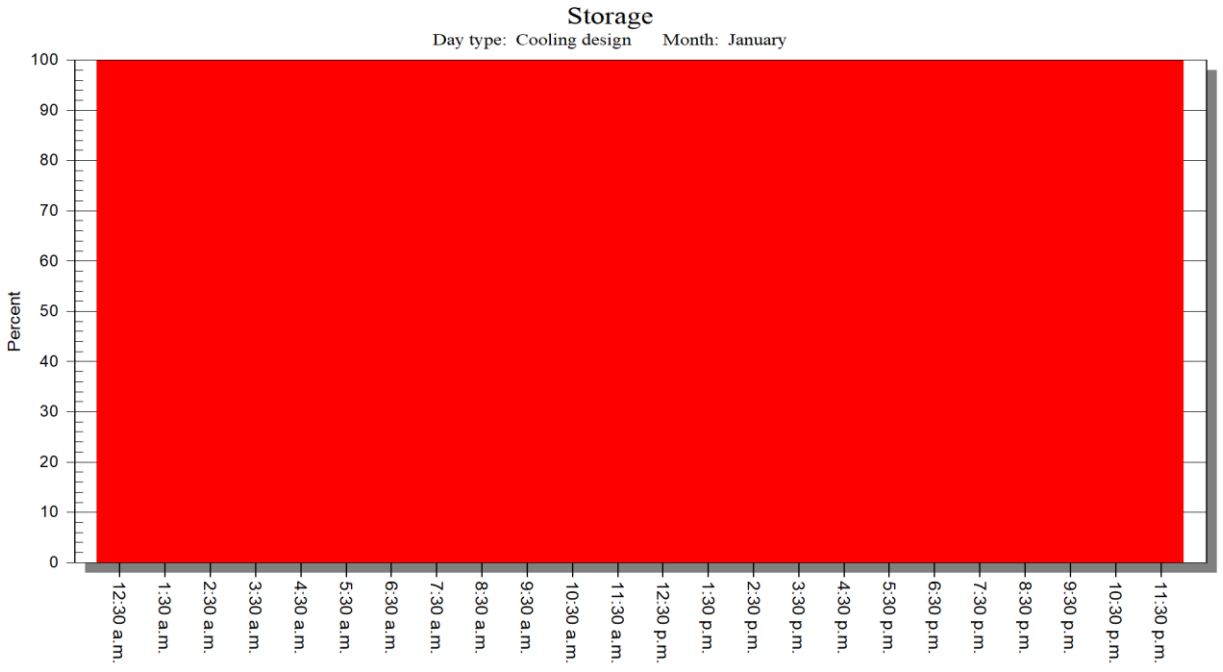





LANL Office Schedule
Day type: Weekday Month: January
Percent
100
90
80
70
60
50
40
30
20
10
0
12:30 a.m.
1:30 a.m.
2:30 a.m.
3:30 a.m.
4:30 a.m.
5:30 a.m.
6:30 a.m.
7:30 a.m.
8:30 a.m.
9:30 a.m.
10:30 a.m.
11:30 a.m.
12:30 p.m.
1:30 p.m.
2:30 p.m.
3:30 p.m.
4:30 p.m.
5:30 p.m.
6:30 p.m.
7:30 p.m.
8:30 p.m.
9:30 p.m.
10:30 p.m.
11:30 p.m.


LANL Break Room
Day type: Weekday Month: January
Percent
100
90
80
70
60
50
40
30
20
10
0
12:30 a.m.
1:30 a.m.
2:30 a.m.
3:30 a.m.
4:30 a.m.
5:30 a.m.
6:30 a.m.
7:30 a.m.
8:30 a.m.
9:30 a.m.
10:30 a.m.
11:30 a.m.
12:30 p.m.
1:30 p.m.
2:30 p.m.
3:30 p.m.
4:30 p.m.
5:30 p.m.
6:30 p.m.
7:30 p.m.
8:30 p.m.
9:30 p.m.
10:30 p.m.
11:30 p.m.


Storage
Day type: Weekday Month: January
Percent
100
90
80
70
60
50
40
30
20
10
0
12:30 a.m.
1:30 a.m.
2:30 a.m.
3:30 a.m.
4:30 a.m.
5:30 a.m.
6:30 a.m.
7:30 a.m.
8:30 a.m.
9:30 a.m.
10:30 a.m.
11:30 a.m.
12:30 p.m.
1:30 p.m.
2:30 p.m.
3:30 p.m.
4:30 p.m.
5:30 p.m.
6:30 p.m.
7:30 p.m.
8:30 p.m.
9:30 p.m.
10:30 p.m.
11:30 p.m.


Storage
Day type: Cooling design Month: January
Percent
100
90
80
70
60
50
40
30
20
10
0
12:30 a.m.
1:30 a.m.
2:30 a.m.
3:30 a.m.
4:30 a.m.
5:30 a.m.
6:30 a.m.
7:30 a.m.
8:30 a.m.
9:30 a.m.
10:30 a.m.
11:30 a.m.
12:30 p.m.
1:30 p.m.
2:30 p.m.
3:30 p.m.
4:30 p.m.
5:30 p.m.
6:30 p.m.
7:30 p.m.
8:30 p.m.
9:30 p.m.
10:30 p.m.
11:30 p.m.

C.3: Systems

SYSTEMS

BASE SYSTEM

System Category	System Type
Variable Volume	Variable Volume Reheat (30% Min Flow Default)

OPTIONS

Section	Parameter	Current Design
Cooling	Type	None
Economizer	Type	Ethalpy
	Max outdoor air	100%
	Schedule	Available (100%)
Stage 1 Air-to-Air Energy Recovery/Transfer	Type	None
	Sup-side Deck	
	Exh-side Deck	
	Schedule	
Stage 2 Air-to-Air Energy Recovery/Transfer	Type	None
	Sup-side Deck	
	Exh-side Deck	
	Schedule	

TEMP/HUMIDITY

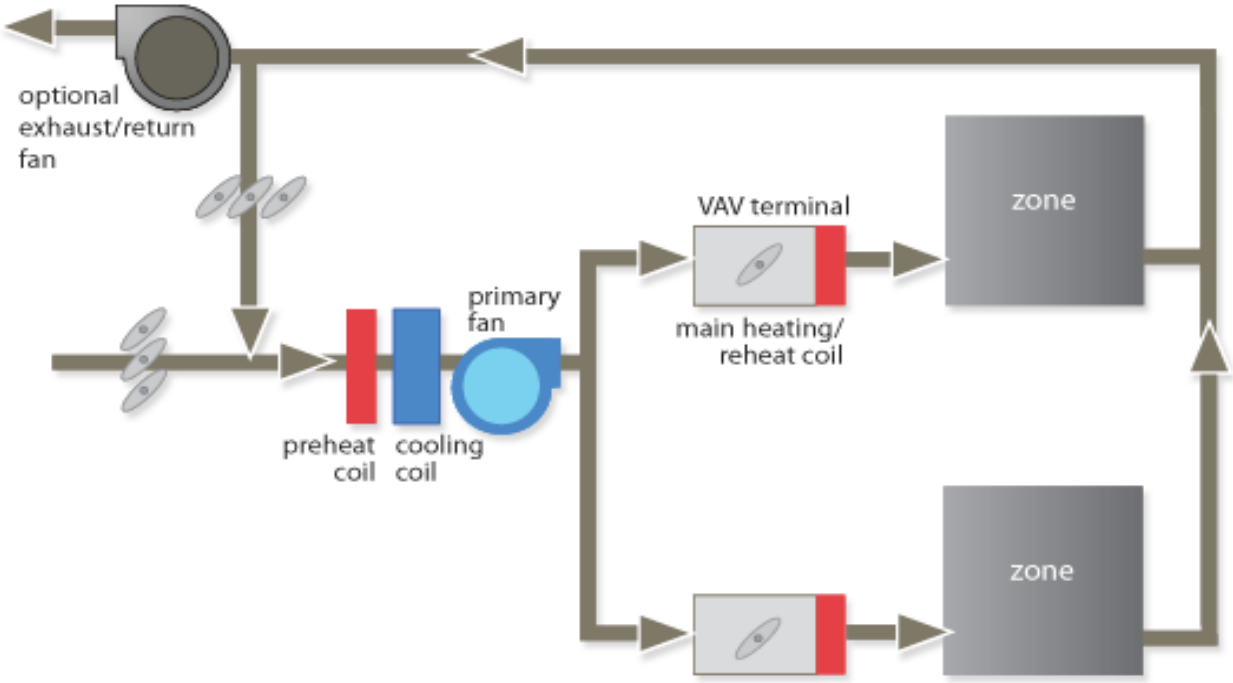
Section	Parameter	Current Design
Design Air Temperature	Cooling Supply Max	To be calculated
	Cooling Supply Min	
	Heating Supply Max	
	Heating Supply Min	
	Supply Duct Temperature Difference	

FANS

Parameter		Current Design		
Fan Cycling Schedule		Cooling Supply Max		
Fan	Type	Static Pressure (in. wg)	Full Load Energy Rate	Schedule
Primary	Centrifugal	4	30 Nominal HP	LANL Vent Schedule
Return	Centrifugal	4	30 Nominal HP	LANL Vent Schedule
System Exhaust	90.1-13 Min VAV AF	2	5 Nominal HP	Available (100%)
Room Exhaust	None			
Option Vent	None			
Auxilary	None			

COILS

Section	Parameter	Current Design	
Diversity	People	75	
	Lights	75	
	Misc Loads	100	
	Capacity	Capacity Units	Schedule
Main Cooling	100%	% of Design Cooling Capacity	LANL Vent Schedule
Main Heating	100%	% of Design Capacity	LANL Vent Schedule
Preheat	100%	% of Design Capacity	LANL Vent Schedule
Reheat	100%	% of Design Capacity	LANL Vent Schedule
Humidification	None		



C.4: Plants

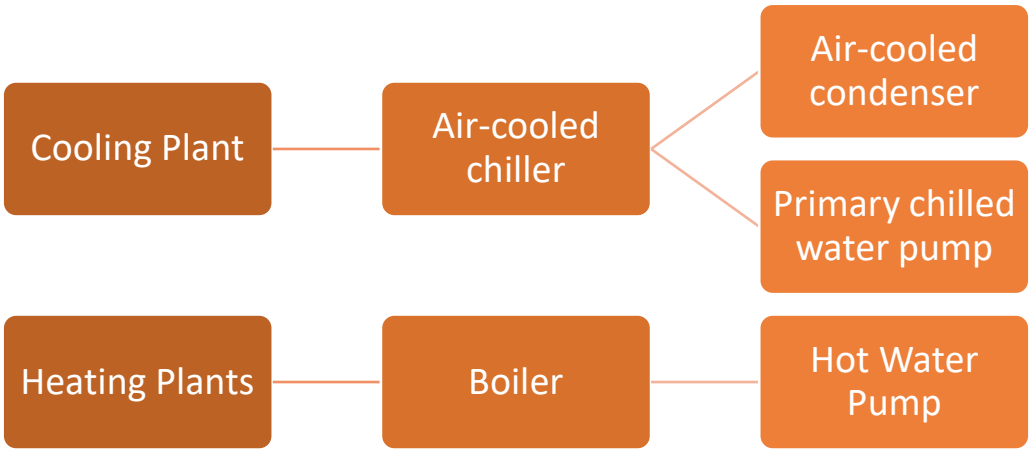
PLANTS

COOLING PLANT

Equipment	Parameter	Baseline Design
Air-Cooled Chiller	Equipment Type	90.1-13 Min Air Cooled Chiller > 150 tons Path A
	Sequencing Type	Single
	Reject Condenser Heat	Heat Rejection Equipment
Heat Rejection	Type	90.1 Min Air Cooled Condenser
	Hourly ambient wet bulb offset	*To be calculated*
Thermal Storage	Type	None
Operating Mode	**Capacity**	**Energy Rate**
Cooling	*To be calculated*	10.1 EER (compressor only)
Heat Recovery	*To be calculated*	*To be calculated*
Tank Charging	*To be calculated*	*To be calculated*
Tank Charging & Heat Recovery	*To be calculated*	*To be calculated*
Pumps	**Type**	**Full Load Consumption**
Primary Chilled water	90.1 Min CV Chilled Water Pump	*To be calculated*
Condenser water	*To be calculated*	*To be calculated*
Heat recovery or aux condenser	*To be calculated*	*To be calculated*

HEATING PLANT

Equipment	Parameter	Baseline Design
Boiler	Equipment Type	90.1-13 Min Boiler, HW, Oil > 2500 MBhr
	Capacity	*To be calculated*
	Energy Rate	82
Hot Water Pump	Type	Heating Water Circ Pump
	Full Load Consumption	*To be calculated*
Thermal Storage	Type	None
Controls	Equipment Schedule	Available (100%)



C.5: Room Templates

C.5.1 Break Room Template

BREAK ROOM

INTERNAL LOAD

Section	Parameter	Parameter Description via TRACE Help	Baseline Design
People	Type	The People Activity Type entry allows you to select typical people densities and loads from the Internal & Airflow Loads Library.	Cafeteria
	Density	--	20 sq ft/person
	Schedule	Schedules allow you to define 24-hour percentage profiles for the variable loads in the room, such as people, lights, miscellaneous equipment, ventilation, infiltration, and more.	LANL Break Room
	Sensible Heat Gain	--	275
	Latent Heat Gain	--	250
Workstations	Density	This field defines the number (or density) of computer workstations located in the room.	0 workstations/person
Lighting	Type	The Lighting Type entry allows you to select typical lighting properties from the Internal & Airflow Loads Library. You may choose a standard member from the library supplied with the program or create your own library member. Property Factors include: lighting fixture type, ballast factor, or percent lighting load to plenum.	LED Lighting 100% Load Space
	Heat Gain	Pay special attention to the lighting load amount that is assigned to the space. Since lighting often accounts for a large portion of a space's load, the amount of load to the space can have a significant effect on the required space airflows. For example, if a room contains 100 Watts of lighting, a fixture that assigns all of that load to the space will result in higher space airflows than a fixture that only releases 20% of the load to the space, since space airflows are calculated using the space sensible	1.3 W/sq ft
	Schedule	Same as above.	LANL Office Schedule
Miscellaneous Loads	Type	The Miscellaneous Loads Type field allows you to select typical miscellaneous equipment properties from the Internal & Airflow Loads Library. You may choose a standard member from the library supplied with the program or create your own library member. This library contains information pertaining to power consumption and heat released for a piece of equipment. This information is used to determine the room (and/or plenum) heat gain due to that equipment. These values can be override on the Create Rooms Section.	Cold Beverage / Vending Machine: 1.26 W/sq ft Refrigerator: .26 W/sq ft
	Schedule	Same as above.	Available (100%)
	Energy Meter	Select the Energy Meter from the drop-down list. This field need only be used if you are performing an energy analysis. It is used to tell the program what utility type is being used to produce the	Electricity
	Data Center Equipment?	--	No

AIRFLOW

Section	Parameter	Parameter Description via TRACE Help	Baseline Design
Main Supply	Cooling	--	*To be calculated*
	Heating	--	*To be calculated*
Ventilation	Method	--	ASHRAE 62.1
	Type	The Ventilation Type entry allows you to select typical ventilation (outside air) requirements/loads from the Internal & Airflow Loads Library. You may choose a standard member from the library supplied with the program or create your own	Break Rooms
	People-based Ventilation	--	5 cfm/sq ft
	Area-based Ventilation	--	0.06 cfm/sq ft
	Schedule	Same as above.	LANL Vent Schedule
Infiltration	Type	This field allows you to select typical infiltration loads from the Internal & Airflow Loads Library. You may choose a standard member from the library supplied with the program or create your	None
	Cooling	Infiltration is intended to model outside air entering the room through windows, leaky construction, or doors. The cooling infiltration airflow is used for the cooling design calculations and the heating infiltration airflow is used for the heating design calculations.	
	Heating		
	Schedule	Same as above.	
Std 62.1-2004-2010	Clg Ez	The zone air distribution effectiveness for cooling (Clg Ez) is a measure of how thoroughly the cooling supply airflow mixes with the air in the breathing zone (which is basically the air up to six feet above the floor). This effectiveness is based on the location of the supply and return air grilles, the velocity of the airflow, and the proximity of the makeup air grille to the exhaust air grille. If the specific Clg Ez for the room is known, this percentage can be entered manually by choosing Custom.	Ceiling clg supply, ceiling return, 100%
	Htg Ez	The zone air distribution effectiveness for heating (Htg Ez) is a measure of how thoroughly the heating supply airflow mixes with the air in the breathing zone (which is basically the air up to 6 feet above the floor). This effectiveness is based on the location of the supply and return air grilles, the temperature of the supply airflow, and the proximity of the makeup air grille to the exhaust air grille. If the specific Htg Ez for the room is known, this percentage can be entered manually by	Ceiling supply > trm+15F, ceiling return, 80%
	Er	The recirculation effectiveness (Er) is used only when the air handling system has a secondary ventilation path, such as a fan-powered VAV or dual duct VAV system.	*Default based on system type.*
	DCV Min OA Intake	ventilation air required for a space when CO2-based demand control ventilation controls are active. This field is only activated if Apply to ASHRAE Std 62.1-2004 is set to "Yes". In	*Ignored*
Room Exhaust	Rate	Room exhaust is defined as room air that is exhausted directly from the room to the atmosphere. Bathroom exhaust, laboratory, or kitchen hood exhaust are typical examples. This air does not mix with the return air and the return airflow seen by the main cooling coil is reduced by the respective amount of Room Exhaust Airflow - Infiltration Airflow. This may impact return/exhaust fan sizing, plenum psychrometrics, and the	None
	Schedule	Same as above.	
VAV Control	Clg VAV min	--	--
	Htg VAV max	--	--
	Schedule	Same as above.	LANL Vent Schedule
	Type	This field is used to model a hybrid VAV system. It would typically be used on a fan-powered VAV system. This allows the user to incorporate shutoff VAV boxes in certain zones connected to a fan powered system where fan powered boxes are not required (for example, on interior zones).	Default

C.5.2 Conference Room Template

CONFERENCE ROOM

INTERNAL LOAD

Section	Parameter	Parameter Description via TRACE Help	Baseline Design
People	Type	--	Conference Room
	Density	--	20 sq ft/person
	Schedule	--	LANL Office Schedule
	Sensible Heat Gain	--	245
	Latent Heat Gain	--	155
Worstations	Density	--	1 workstation / person
Lighting	Type	--	LED Lighting 100% Load Space
	Heat Gain	--	1.3 W/sq ft
	Schedule	--	LANL Office Schedule
Miscellaneous Loads	Type	--	Std. Office Equipment
	Energy	--	0.4 W/sq ft
	Schedule	--	LANL Office Schedule
	Energy Meter	--	Electricity
	Data Center Equipment?	--	No

AIRFLOW

Section	Parameter	Parameter Description via TRACE Help	Baseline Design
Main Supply	Cooling	--	*To be calculated*
	Heating	--	*To be calculated*
Ventilation	Method	--	ASHRAE 62.1
	Type	--	Conference / meeting
	People-based Ventilation	--	5 cfm/sq ft
	Area-based Ventilation Rate	--	0.06 cfm/sq ft
	Schedule	--	LANL Vent Schedule
Infiltration	Type	--	None
	Cooling	--	
	Heating		
	Schedule	--	
Std 62.1-2004-2010	Clg Ez	--	Ceiling clg supply, ceiling return, 100%
	Htg Ez	--	Ceiling supply > trm+15F, ceiling return, 80%
	Er	--	*Default based on system type.*
	DCV Min OA Intake	--	*Ignored*
Room Exhaust	Rate	--	None
	Schedule	--	
VAV Control	Clg VAV min	--	--
	Htg VAV max	--	--
	Schedule	--	LANL Vent Schedule
	Type	--	Default

THERMOSTAT

Section	Parameter	Parameter Description via TRACE Help	Baseline Design
Thermostat settings	Cooling Dry Bulb	This value represents the thermostat setpoint for the room during cooling design calculations. It is used to calculate room cooling loads, design cooling coil capacities, and design fan capacities.	72
	Heating Dry Bulb	This value represents the thermostat setpoint for the room during heating design calculations. It is used to calculate room heating loads, design heating coil capacities, and design fan capacities.	72
	Relative Humidity	This value represents the relative humidity setpoint for the room during cooling design calculations. Enter this value as a whole number percentage (i.e. 50% RH would be entered as 50, not 0.50).	50
	Cooling Driftpoint	The cooling thermostat driftpoint is the highest temperature that the room is allowed to drift up to during periods of low or no occupancy. (This is also referred to as the cooling setup temperature.) If the room temperature starts to rise above this value, the available cooling equipment will be activated to allow cooling of this room.	76
	Heating Driftpoint	The heating thermostat driftpoint is the lowest temperature that the room is allowed to drift down to during periods of low or no occupancy. (This is also referred to as the heating setback temperature.) If the room temperature starts to fall below this value, the available heating equipment will be activated to allow heating of this room.	67
	Cooling Schedule	To define the cooling thermostat schedule: use the Schedule Utility (Library/Template editors) to define a cooling thermostat profile and then enter the schedule code name in this field.	LANL Vent Schedule
	Heating Schedule	To define the heating thermostat schedule: use the Schedule Utility (Library/Template editors) to define a cooling thermostat profile and then enter the schedule code name in this field.	LANL Vent Schedule
Sensor Locations	Thermostat	--	Room
	CO2 Sensor	--	Room
Humidity	Moisture Capacitance	Enter the room's moisture capacitance as either None, Low, Medium, or High. A selection of None means that the room has no moisture capacitance, i.e., the room moisture levels are steady state from one hour to the next and so the room relative humidity is purely a function of the moisture entering and leaving the room that hour; none is absorbed. Choose either Low, Medium, or High when moisture-absorbing materials and furnishings are present in the space. For example, a gymnasium or cafeteria would have little moisture capacitance and would typically be represented by a Low selection. A library, with its numerous books,	None
	Humidistat Location	--	None

C.5.3 Corridor Template

INTERNAL LOAD

Section	Parameter	Parameter Description via TRACE Help	Baseline Design
People	Type	--	General Office Space
	Density	--	143 sq ft / person
	Schedule	--	LANL Office Schedule
	Sensible Heat Gain	--	225
	Latent Heat Gain	--	105
Worstations	Density	--	0
Lighting	Type	--	LED Lighting 100% Load Space
	Heat Gain	--	0.5 W/ sq ft
	Schedule	--	LANL Office Schedule
Miscellaneous Loads	Type	--	None
	Energy	--	
	Schedule	--	
	Energy Meter	--	
	Data Center Equipment?	--	

AIRFLOW

Section	Parameter	Parameter Description via TRACE Help	Current Design
Main Supply	Cooling	--	*To be calculated*
	Heating	--	*To be calculated*
Ventilation	Method	--	Sum of Outdoor Air
	Type	--	Corridors
	Cooling	--	0 cfm/person
	Heating	--	0.06 cfm / sq ft
	Schedule	--	LANL Vent Schedule
Infiltration	Type	--	None
	Cooling		
	Heating	--	
	Schedule	--	
Std 62.1-2004-2010	Clg Ez	--	Ceiling clg supply, ceiling return, 100%
	Htg Ez	--	Ceiling supply > trm+15F, ceiling return, 80%
	Er	--	*Default based on system type.*
	DCV Min OA Intake	--	*Ignored*
Room Exhaust	Rate	--	0 air changes/hr
	Schedule	--	--
VAV Control	Clg VAV min	--	--
	Htg VAV max	--	--
	Schedule	--	LANL Vent Schedule
	Type	--	Default

C.5.4 General Office Template

GENERAL OFFICE

INTERNAL LOAD

Section	Parameter	Parameter Description via TRACE Help	Baseline Design
People	Type	--	General Office Space
	Density	--	2 people **or** 120 sq ft/person
	Schedule	--	LANL Office Schedule
	Sensible Heat Gain	--	250 Btu/h
	Latent Heat Gain	--	200 Btu/h
Workstations	Density	--	60 sq ft/work station
Lighting	Type	--	LED Lighting 100% Load Space
	Heat Gain	--	1.3 W/sq ft
	Schedule	--	LANL Office Schedule
Miscellaneous Loads	Type	--	Std. Office Equipment
	Energy	--	1 W/sq ft
	Schedule	--	LANL Office Schedule
	Energy Meter	--	Electricity
	Data Center Equipment?	--	No

AIRFLOW

Section	Parameter	Parameter Description via TRACE Help	Baseline Design
Main Supply	Cooling	--	*To be calculated*
	Heating	--	*To be calculated*
Ventilation	Method	--	ASHRAE 62.1
	Type	--	Office space
	People-based Ventilation	--	5 cfm/person
	Area-based Ventilation	--	.06 cfm/sq ft
	Schedule	--	LANL Vent Schedule
Infiltration	Type	--	None
	Cooling		
	Heating	--	
	Schedule	--	
Std 62.1-2004-2010	Clg Ez	--	100%
	Htg Ez	--	return, 80%
	Er	--	*Default based on system type.*
	DCV Min OA Intake	--	*Ignored*
Room Exhaust	Rate	--	0 air changes/hr
VAV Control	Clg VAV min	--	--
	Htg VAV max	--	--
	Schedule	--	LANL Vent Schedule
	Type	--	Default

THERMOSTAT

Section	Parameter	Parameter Description via TRACE Help	Baseline Design
Thermostat settings	Cooling Dry Bulb	--	72
	Heating Dry Bulb	--	72
	Relative Humidity	--	50
	Cooling Driftpoint	--	78
	Heating Driftpoint	--	67
	Cooling Schedule	--	LANL Vent Schedule
	Heating Schedule	--	LANL Vent Schedule
Sensor Locations	Thermostat	--	Room
	CO2 Sensor	--	None
Humidity	Moisture Capacitance	--	None
	Humidistat Location	--	None

C.5.5 IT and Communications Template

IT and Communications

INTERNAL LOAD

Section	Parameter	Parameter Description via TRACE Help	Baseline Design
People	Type	--	General Office Space
	Density	--	40 sq ft/ person
	Schedule	--	LANL Office Schedule
	Sensible Heat Gain	--	250
	Latent Heat Gain	--	200
Worstations	Density	--	3 workstations
Lighting	Type	--	LED Lighting 100% Load Space
	Heat Gain	--	1.3 W/sq ft
	Schedule	--	LANL Office Schedule
Miscellaneous Loads	Type	---	Eight, 240W Duplex Recepticales: 1.92 kW
			Four, 2400W Twist-lock Receptacles for Equipment Cabinets: 9.6kW
	Schedule	--	LANL Office Schedule
	Energy Meter	--	Electricity
	Data Center Equipment?	--	No

C.5.6 Printing/Copying Room Template

PRINTING ROOM

INTERNAL LOAD

Section	Parameter	Parameter Description via TRACE Help	Baseline Design
People	Type	--	General Office Space
	Density	--	100 sq ft/ person
	Schedule	--	LANL Office Schedule
	Sensible Heat Gain	--	250
	Latent Heat Gain	--	200
Worstations	Density	--	1 workstation / person
Lighting	Type	--	LED Lighting 100% Load Space
	Heat Gain	--	1.3 W/sq ft
	Schedule	--	LANL Office Schedule
Miscellaneous Loads	Type	--	Office Copier
	Energy	--	600W
	Schedule	--	LANL Office Schedule
	Energy Meter	--	Electricity
	Data Center Equipment?	--	No

AIRFLOW

Section	Parameter	Parameter Description via TRACE Help	Baseline Design
Main Supply	Cooling	--	*To be calculated*
	Heating	--	*To be calculated*
Ventilation	Method	--	ASHRAE 62.1
	Type	--	Office Space
	People-based Ventilation	--	5
	Area-based Ventilation	--	0.5
	Schedule	--	LANL Vent Schedule
Infiltration	Type	--	Non e
	Cooling		
	Heating	--	
	Schedule	--	
Std 62.1-2004-2010	Clg Ez	--	Ceiling clg supply, ceiling return, 100%
	Htg Ez	--	Ceiling supply > trm+15F, ceiling return, 80%
	Er	--	*Default based on system type.*
	DCV Min OA Intake	--	*Ignored*
Room Exhaust	Rate	--	.5 cfm/sq ft
	Schedule	--	LANL Vent Schedule
VAV Control	Clg VAV min	--	--
	Htg VAV max	--	--
	Schedule	--	LANL Vent Schedule
	Type	--	Default

C.5.7 Reception Areas Template

RECEPTION AREA

INTERNAL LOAD

Section	Parameter	Parameter Description via TRACE Help	Baseline Design
People	Type	--	Reception Area
	Density	--	16.7
	Schedule	--	LANL Office Schedule
	Sensible Heat Gain	--	245
	Latent Heat Gain	--	155
Worstations	Density	--	1 workstation
Lighting	Type	--	LED Lighting 100% Load Space
	Heat Gain	--	1.3 W/sq ft
	Schedule	--	LANL Office Schedule
Miscellaneous Loads	Type	--	Std Office Equipment
	Energy	--	.5 W/sq ft
	Schedule	--	LANL Office Schedule
	Energy Meter	--	Electricity
	Data Center Equipment?	--	No

C.5.8 Rednet Room Template

REDNET ROOM

INTERNAL LOAD

Section	Parameter	Parameter Description via TRACE Help	Baseline Design
People	Type	--	None
	Density	--	0
	Schedule	--	Storage
	Sensible Heat Gain	--	0
	Latent Heat Gain	--	0
Worstations	Density	--	0
Lighting	Type	--	LED Lighting 100% Load Space
	Heat Gain	--	1.3 W/sq ft
	Schedule	--	LANL Office Schedule
Miscellaneous Loads	Type	--	3 Server Racks: 6 kW.
			Cooling Load 7.5 kW
	Schedule	--	Available (100%), Available (50%)
	Energy Meter	--	Electricity
	Data Center Equipment?	--	No

C.5.9 Restroom Template

RESTROOM

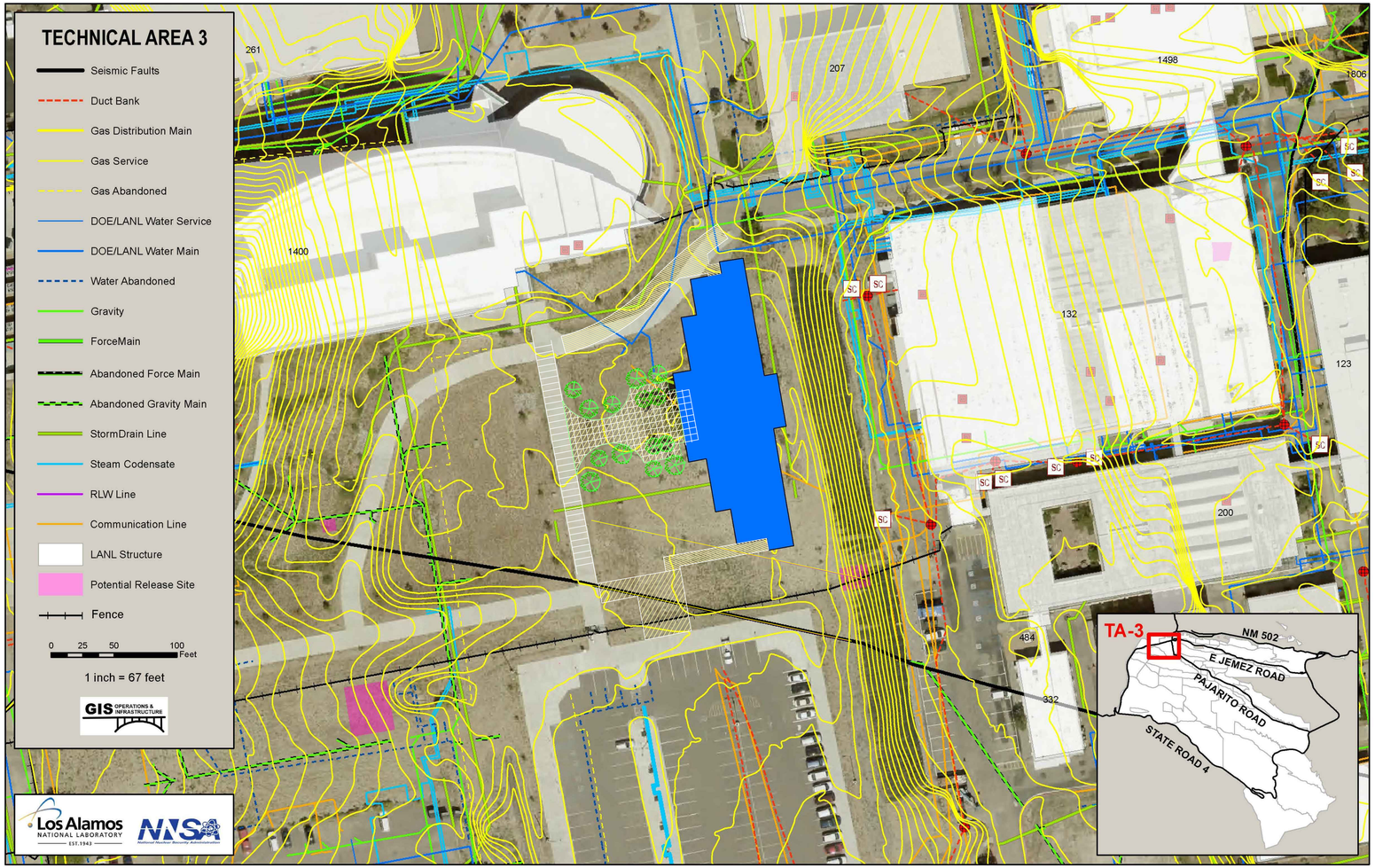
INTERNAL LOAD

Section	Parameter	Parameter Description via TRACE Help	Baseline Design
People	Type	--	None
	Density	--	3
	Schedule	--	LANL Break Room
	Sensible Heat Gain	--	225
	Latent Heat Gain	--	105
Worstations	Density	--	0
Lighting	Type	--	LED Lighting 100% Load Space
	Heat Gain	--	0.9 W/sq ft
	Schedule	--	LANL Office Schedule
Miscellaneous Loads	Type	--	None
	Energy	--	
	Schedule	--	
	Energy Meter	--	
	Data Center Equipment?	--	

AIRFLOW

Section	Parameter	Parameter Description via TRACE Help	Current Design
Main Supply	Cooling	--	*To be calculated*
	Heating	--	*To be calculated*
Ventilation	Method	--	Sum of Outdoor Air
	Type	--	Restroom
	Cooling	--	2 cfm
	Heating	--	2 cfm
	Schedule	--	LANL Vent Schedule
Infiltration	Type	--	None
	Cooling	--	
	Heating		
	Schedule	--	
Std 62.1-2004-2010	Clg Ez	--	Ceiling clg supply, ceiling return, 100%
	Htg Ez	--	Ceiling supply > trm+15F, ceiling return, 80%
	Er	--	*Default based on system type.*
	DCV Min OA Intake	--	*Ignored*
Room Exhaust	Rate	--	0 air changes/hr
	Schedule	--	--
VAV Control	Clg VAV min	--	--
	Htg VAV max	--	--
	Schedule	--	LANL Vent Schedule
	Type	--	Default

Appendix D: Conceptual Floor Plans and Elevations



1 Concept - Site Plan

Scale: 1/8" = 1'-0"

Operations & Infrastructure

Infrastructure Planning

NO	DATE	CLASS REV	DESCRIPTION	DWN	VER	CHKD	SUB	APP

General Office Building

Concept Site Plan

DRAWN	M. Bodelson
VERIFIED	K. Towery
CHECKED	M. Benake
DATE	07-03-18

BLDG. n/a TA– 03

SUBMITTED PROJ_ENG

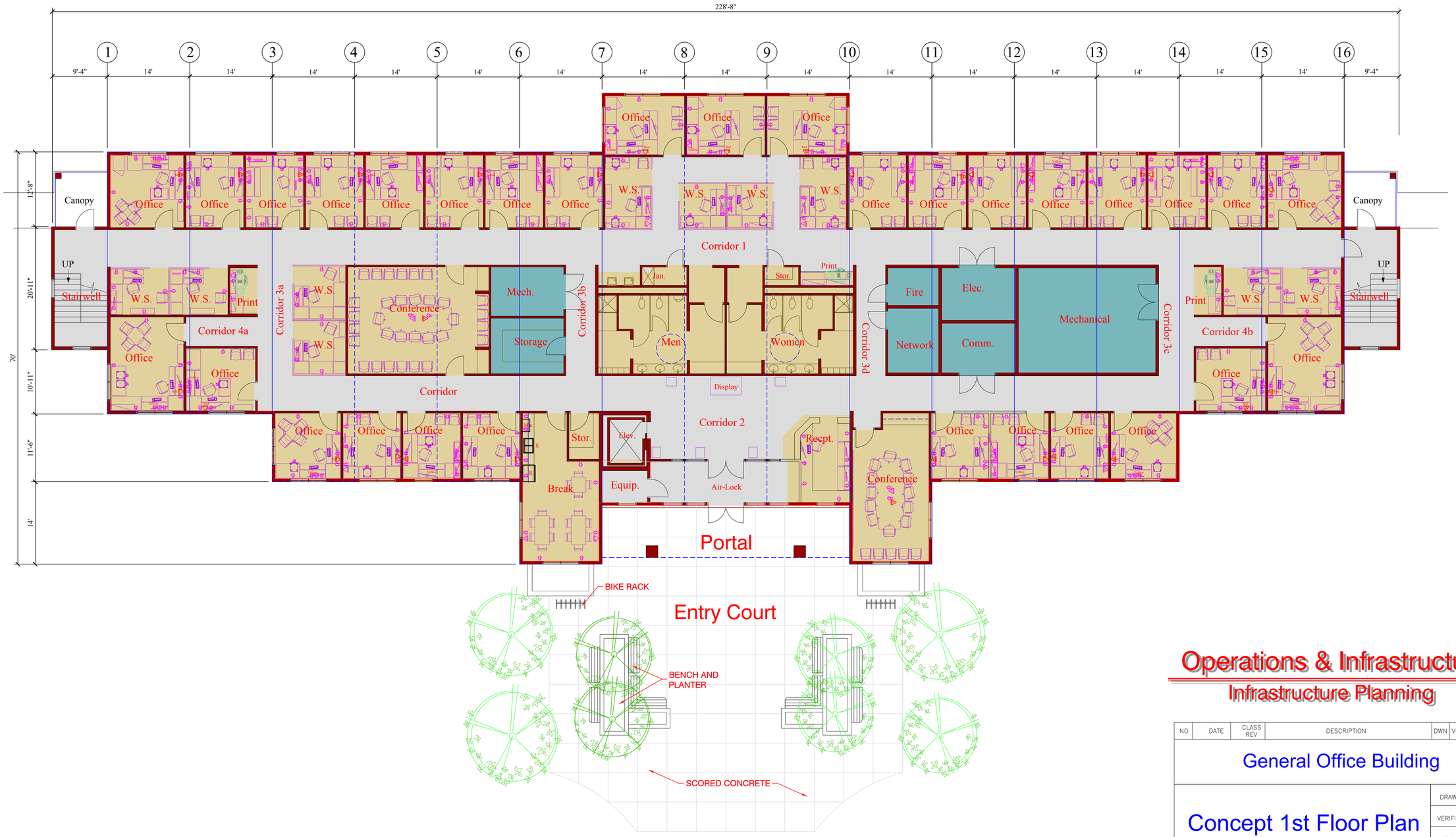
APPROVED FOR RELEASE PROJ_LEAD

Los Alamos NATIONAL LABORATORY PO Box 1663 Los Alamos, New Mexico 87545

SHEET 1 OF 4

CLASSIFICATION UNCLASSIFIED REVIEWER M. Bodelson DATE 07-03-18

PROJECT ID 000000 DRAWING NO REV 0



1 Concept First Floor Plan

Scale: 1/8" = 1'-0"

Operations & Infrastructure

Infrastructure Planning

NO	DATE	CLASS REV	DESCRIPTION	DWN	VER	CHKD	SUB	APP

General Office Building

Concept 1st Floor Plan

DRAWN	M. Bodelson
VERIFIED	K. Towery
CHECKED	M. Benake
DATE	07-03-18

BLDG. N/A TA– 03

SUBMITTED PROJ_ENG

APPROVED FOR RELEASE PROJ_LEAD

Los Alamos NATIONAL LABORATORY PO Box 1663 Los Alamos, New Mexico 87545

SHEET 2 OF 4

CLASSIFICATION UNCLASSIFIED REVIEWER M. Bodelson DATE 07-03-18

PROJECT ID 000000 DRAWING NO REV 0

1 Concept Second Floor Plan

Scale: 1/8" = 1'-0"

Operations & Infrastructure

Infrastructure Planning

NO	DATE	CLASS REV	DESCRIPTION	DWN	VER	CHKD	SUB	APP

General Office Building

Concept 2nd Floor Plan

DRAWN	M. Bodelson
VERIFIED	K. Towery
CHECKED	M. Benake
DATE	07-03-18

BLDG. n/a TA– 03

SUBMITTED PROJ_ENG

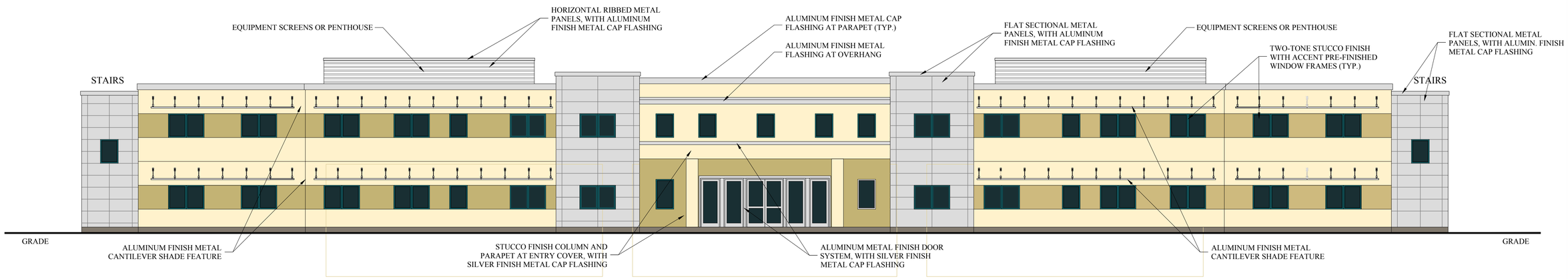
APPROVED FOR RELEASE PROJ_LEAD

Los Alamos NATIONAL LABORATORY PO Box 1663 Los Alamos, New Mexico 87545

SHEET 3 OF 4

CLASSIFICATION UNCLASSIFIED REVIEWER M. Bodelson DATE 07-03-18

PROJECT ID 000000 DRAWING NO REV 0



1 Concept - West Elevation

Scale: 1/8" = 1'-0"

General Concept Attributes:

66 Private Offices
12 Open Offices
4 Conference Rooms
2 Break Rooms
6 Print Stations
2 Network Rooms
2 Electrical Rooms
1 Fire Protectin Room
2 Communications Rooms
Various Storage Rooms

CONCEPT CODE DATA:

PRIMARY APPLICABLE CODES:
2015 INTERNATIONAL BUILDING CODE
2015 INTERNATIONAL MECHANICAL CODE
2014 NATIONAL ELECTRICAL CODE (NFPA 70)
2017 LIFE SAFEY CODE (NFPA 101)
(OTHER RELATED OR SUB-SYSTEM CODES)

OCCUPANCY GROUP:
GROUP-B (BUSINESS)
OFFICE, PROFESSIONAL

CONSTRUCTION TYPE:
II-B NONCOMBUSTIBLE / NON-PROTECTED
FULL FIRE SPRINKLER PROTECTION AND ALARMS

ALLOWABLE AREA:

OCCUPANCY/TYPE	PROPOSED S.F.	ALLOWABLE S.F.
B-OCC. / TYPE II-B	24,000	92,000

(MULTI-STORY, FULLY SPRINKLERED)
(INCREASE FOR AREA SEPARATION NOT INCLUDED)

BUILDING HEIGHT:
ALLOWABLE HEIGHT = 3 STORIES / 75'
ACTUAL HEIGHT = 2 STORY / 24'±

OCCUPANT LOAD:
PROPOSED: 24,000 / 100 = 240
TOTAL OCCUPANT LOAD 240

REQUIRED EXITS:
OFFICE/RESEARCH AT 240: 2 EXITS REQUIRED
3 EXITS PROVIDED

REQUIRED EXIT WIDTH:
TOTAL OCCUPANT LOAD (240) X .2 = 48" EXIT WIDTH REQU.
EXIT WIDTH PROVIDED = 32" X 4 = 128"
PROVIDED WIDTH (128") > REQUIRED WIDTH (48")

EXIT TRAVEL DISTANCE (SPRINKLER):
ALLOWABLE EXIT TRAVEL DISTANCE = 300'
ACTUAL EXIT TRAVEL DISTANCE = 115'

COMMON TRAVEL DISTANCE:
ALLOWABLE COMMON TRAVEL DISTANCE = 100' (SPRINKLER)'
ACTUAL COMMON TRAVEL DISTANCE = 40'

PLUMBING REQUIREMENTS:
TOTAL OCCUPANT LOAD = 240
MALE 120 OCCUPANTS:
TOILET 1:25 (1st 50), THEN 1:50 = 5 MIN.
LAV. 1:40 (1ST 80), THEN 1:80 = 2 MIN.

FEMALE 120 OCCUPANTS:
TOILET 1:25 (1st 50), THEN 1:50 = 5 MIN.
LAV. 1:40 (1ST 80), THEN 1:80 = 2 MIN.

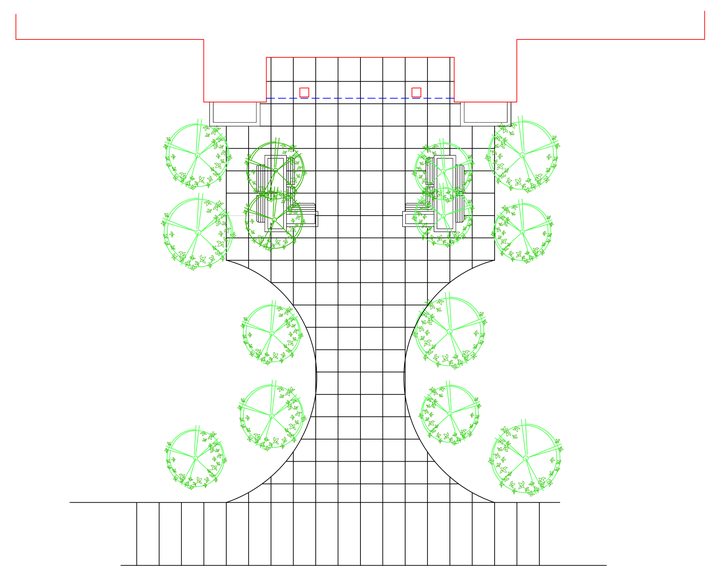
DRINKING FOUNTAIN: 1:100 = 3 REQUIRED
SERVICE SINK: 1 REQUIRED

CORRIDOR FIRE RATING AND MIN. WIDTH
FIRE RATED CORRIDOR (SPRINKLER) = 0 HOURS
MINIMUM CORRIDOR WIDTH - 44"

ACCESSIBILITY REQUIREMENTS
MEET IBC AND ADA ACCESS REQUIREMENTS

MANAGEMENT LEVEL (ML)
RISK CATEGORY (RC)

PRELIMINARY RATINGS
ML RATING: ML-4
RC RATING: RC-1



1 Concept - Entry Court

Scale: 1/16" = 1'-0"

Operations & Infrastructure
Infrastructure Planning

NO	DATE	CLASS REV	DESCRIPTION	DWN	VER	CHKD	SUB	APP

General Office Building

Concept Floor Plan

DRAWN	M. Bodelson
VERIFIED	K. Towery
CHECKED	M. Benake
DATE	07-03-18

BLDG. n/a TA– 03

SUBMITTED PROJ_ENG
APPROVED FOR RELEASE PROJ_LEAD

Los Alamos NATIONAL LABORATORY
PO Box 1663
Los Alamos, New Mexico 87545

SHEET 4
4 OF 4

CLASSIFICATION UNCLASSIFIED
REVIEWER M. Bodelson
DATE 07-03-18
PROJECT ID 000000
DRAWING NO
REV 0

Appendix E: Baseline Report

PROJECT INFORMATION

Location	
Building owner	
Program user	
Company	
Comments	**WING_TEMPLATE_PROCESSING**

By	**LANL**
Dataset name	**Z:\2018\Individual Projects\Applicability of Modular Net-Zero Campus\TRACE 700\Baseline.trc**

Calculation time	**02:09 PM on 08/06/2018**	
TRACE® 700 version	**6.3.4**	
Location	**Los Alamos, New Mexico**	
Latitude	**36.0**	**deg**
Longitude	**106.0**	**deg**
Time Zone	**7**	
Elevation	**7,410**	**ft**
Barometric pressure	**22.5**	**in. Hg**
Air density	**0.0570**	**lb/cu ft**
Air specific heat	**0.2444**	**Btu/lb·°F**
Density-specific heat product	**0.8355**	**Btu/h·cfm·°F**
Latent heat factor	**3,677.8**	**Btu·min/h·cu ft**
Enthalpy factor	**3.4181**	**lb·min/hr·cu ft**
Summer design dry bulb	**89.0**	**°F**
Summer design wet bulb	**60.0**	**°F**
Winter design dry bulb	**5.0**	**°F**
Summer clearness number	**1.10**	
Winter clearness number	**1.05**	
Summer ground reflectance	**0.20**	
Winter ground reflectance	**0.20**	
Carbon Dioxide Level	**400**	**ppm**
Design simulation period	**January - December**	
Cooling load methodology	**RTS (Heat Balance)**	
Heating load methodology	**CLTD-CLF (ASHRAE-TFM)**	

System Component Selection Summary

By LANL

Alternative 1

System Description: Base System

System Type: Variable Volume Reheat (30% Min Flow Default)
Number of Zones: 18
Number of Rooms: 70

Component	Sizing Method	Location	Quantity	
Cooling				
Main Clg Coil	Block	System	1	
Primary Clg Fan	Block	System	1	
Heating				
Main Htg Coil	Peak	Zone	18	
Preheat Coil	Peak	System	1	Peak sizing for VAV systems based on worst case of design airflow and 100% OA at minimum airflow
Miscellaneous				
System Exhaust Fan	Vent+Inf-RmExh	System	1	
Return Fan	Return Airflow	System	1	
VAV Boxes	Block	Zone	18	

Coil Location			Cooling Coil Selection											
				Time Of Peak	Total Capacity		Sensible Capacity	Airflow At Coil Peak	Enter DB/ WB/ HR			Leave DB/ WB/ HR		
System	Zone	Room	Component	Mo/Hr	ton	MBh	MBh	cfm	°F	°F	gr/lb	°F	°F	gr/lb
Base System			Main Clg Coil	7/15	64.5	773.7	638.9	26,850	80.5	58.3	61.7	52.2	46.1	51.8

Coil Location			Heating Coil Selection				
System	Zone	Room	Component	Total Capacity MBh	Airflow cfm	Entering Dry Bulb °F	Leaving Dry Bulb °F
Base System			Preheat Coil	-460.3	11,680	5.0	52.2
	Zone - 001		Main Htg Coil	-23.7	303	52.2	145.8
	Zone - 002		Main Htg Coil	-16.2	575	52.2	85.8
	Zone - 003		Main Htg Coil	-18.3	515	52.2	94.6
	Zone - 004		Main Htg Coil	-0.9	44	52.2	76.2
	Zone - 005		Main Htg Coil	-0.9	44	52.2	75.7
	Zone - 006		Main Htg Coil	-0.9	45	52.2	75.9
	Zone - 007		Main Htg Coil	-0.8	43	52.2	75.4
	Zone - 008		Main Htg Coil	-0.8	43	52.2	75.0
	Zone - 009		Main Htg Coil	-0.9	56	52.2	70.3
	Zone - 010		Main Htg Coil	-0.6	30	52.2	74.4
	Zone - 011		Main Htg Coil	-0.5	30	52.2	70.8
	Zone - 012		Main Htg Coil	-0.5	30	52.2	72.6
	Zone - 013		Main Htg Coil	-0.4	27	52.2	70.7
	Zone - 014		Main Htg Coil	-0.5	30	52.2	70.0
	Zone - 015		Main Htg Coil	-2.9	188	54.1	72.5
	Zone - 016		Main Htg Coil	-10.7	712	52.4	70.3
	Zone - 017		Main Htg Coil	-7.0	455	51.8	70.3
	Zone - 018		Main Htg Coil	-9.9	338	52.2	87.3

System Component Selection Summary

By LANL

Component Location			Miscellaneous Component Selection							
				Design Airflow			SADB		Clg VAV	Htg VAV
System	Zone	Room	Component	cfm	Ach/hr	Outside Air %	Clg °F	Htg °F	Minimum cfm	Maximum cfm
Base System			Primary Fan	29,228		40.0	55.0		12,086	12,086
Base System			Return Fan	33,643						
Base System			Optional Vent Fan	11,680		100				
Base System			System Exhaust Fan	29,228						
	Zone - 001		VAV Box	1,778		34.6	55.0	146.0	624	303
		Office1	Diffuser	1,818	14.8	31.2			575	575
		Office2	Diffuser	697	16.2	29.6			209	209
		Office3	Diffuser	1,543	11.8	32.9			515	515
	Zone - 002		VAV Box	1,818		31.2	55.0	86.0	575	575
		Office4	Diffuser	697	16.2	29.6			209	209
		Office5	Diffuser	697	16.2	29.6			209	209
		Office6	Diffuser	524	12.2	29.6			157	157
	Zone - 003		VAV Box	1,543		32.9	55.0	95.0	515	515
		Office7	Diffuser	524	12.2	29.6			157	157
		Office8	Diffuser	697	16.2	29.6			209	209
		Office9	Diffuser	495	8.4	29.6			149	149
	Zone - 004		VAV Box	3,135		4.9	55.0	76.0	157	44
		Office10	Diffuser	739	12.5	29.6			222	222
		Office11	Diffuser	1,120	18.9	29.6			336	336
		Office12	Diffuser	697	16.2	29.6			209	209
		Workspace 1	Diffuser	682	3.9	29.6			205	205
	Zone - 005		VAV Box	4,290		3.6	55.0	76.0	157	44
		Office13	Diffuser	3,135	9.3	4.9			157	44
		Office14	Diffuser	524	12.2	29.6			157	157
		Office15	Diffuser	697	16.2	29.6			209	209
	Zone - 006		VAV Box	5,632		4.6	55.0	76.0	260	45
		Office16	Diffuser	697	16.2	29.6			209	209
		Office17	Diffuser	4,290	10.1	3.6			157	44
		Office18	Diffuser	697	16.2	29.6			209	209
	Zone - 007		VAV Box	7,737		2.8	55.0	75.0	221	43
		Office19	Diffuser	772	14.1	29.6			232	232
		Office20	Diffuser	1,100	15.9	29.6			330	330
		Office21	Diffuser	5,632	11.0	4.6			260	45
		Printer Area 2	Diffuser	43	4.1	29.6			43	43
		Workspace 2b	Diffuser	308	5.6	29.6			93	93
	Zone - 008		VAV Box	9,900		1.5	55.0	75.0	154	43
		Office22	Diffuser	1,086	25.7	29.6			326	326

System Component Selection Summary

By LANL

Component Location			Miscellaneous Component Selection							
				Design Airflow		Outside Air	SADB		Clg VAV	Htg VAV
System	Zone	Room	Component	cfm	Ach/hr	%	Clg °F	Htg °F	Minimum cfm	Maximum cfm
		Office23	Diffuser	737	18.3	29.6			221	221
		Office24	Diffuser	514	12.8	29.6			154	154
		Office25	Diffuser	7,737	11.1	2.8			221	43
	Zone - 009		VAV Box	3,338		8.0	55.0	70.0	269	56
		Break Room1	Diffuser	1,389	11.7	29.6			417	417
		Conference Room1	Diffuser	1,577	13.3	29.6			473	473
		Reception Area	Diffuser	511	11.5	29.6			153	153
	Zone - 010		VAV Box	11,176		0.2	55.0	74.0	30	30
		Office26	Diffuser	737	18.3	29.6			221	221
		Office27	Diffuser	9,900	12.0	1.5			154	43
		Office28	Diffuser	737	18.3	29.6			221	221
	Zone - 011		VAV Box	4,710		0.2	55.0	71.0	30	30
		Office29	Diffuser	882	20.9	29.6			264	264
		Office30	Diffuser	764	17.5	29.6			229	229
		Office31	Diffuser	3,338	11.8	8.0			269	56
	Zone - 012		VAV Box	18,837		0.0	55.0	73.0	30	30
		Corridor 1	Diffuser	676	1.4	29.6			221	221
		Corridor 2	Diffuser	538	1.4	29.6			174	174
		Corridor 3a	Diffuser	70	1.5	29.6			21	21
		Corridor 3b	Diffuser	11,176	12.4	0.2			30	30
		Corridor 3c	Diffuser	61	1.5	29.6			19	19
		Corridor 3d	Diffuser	70	1.5	29.6			21	21
		Corridor 4a	Diffuser	33	1.5	29.6			10	10
		Corridor 4b	Diffuser	4,710	12.8	0.2			30	30
		Entrance Vestibule	Diffuser	1,159	35.5	29.6			348	348
		North Stairwell	Diffuser	375	5.8	29.6			113	113
		South Stairwell	Diffuser	473	7.3	29.6			142	142
	Zone - 013		VAV Box	1,498		0.3	55.0	71.0	30	27
		Conference Room 2	Diffuser	966	7.1	29.6			318	318
		Printer Area 1	Diffuser	43	4.1	29.6			43	43
		Workspace 2a	Diffuser	308	5.6	29.6			93	93
		Workspace 3	Diffuser	201	4.8	29.6			60	60
	Zone - 014		VAV Box	2,271		1.1	55.0	70.0	30	30
		Equipment Room	Diffuser	135	5.3	29.6			41	41
		Small Mechanical Room	Diffuser	2,079	56.9	29.6			624	624
		Storage Room	Diffuser	68	1.5	29.6			21	21
	Zone - 015		VAV Box	18,837		0.6	55.0	73.0	188	188

System Component Selection Summary

By LANL

Component Location			Miscellaneous Component Selection							
				Design Airflow		Outside Air	SADB		Clg VAV	Htg VAV
System	Zone	Room	Component	cfm	Ach/hr	%	Clg °F	Htg °F	Minimum cfm	Maximum cfm
		Janitor Closet	Diffuser	17	1.5	29.6			5	5
		Mens Restroom	Diffuser	152	1.7	29.6			46	46
		Printer Area 3	Diffuser	62	4.1	29.6			62	62
		Storage Area 2	Diffuser	18,837	7.6	0.0			30	30
		Womens Restroom	Diffuser	152	1.7	29.6			46	46
	Zone - 016		VAV Box	2,367		28.7	55.0	70.0	715	712
		Electrical Equipment Room	Diffuser	58	1.5	29.6			18	18
		Fire Riser Room	Diffuser	1,498	6.2	0.3			30	27
		Large Mechanical Room	Diffuser	2,208	17.1	29.6			662	662
		Storage Room 2	Diffuser	15	1.5	29.6			5	5
	Zone - 017		VAV Box	2,271		19.6	55.0	70.0	455	455
		Communications Room	Diffuser	167	5.2	29.6			50	50
		Network Room	Diffuser	2,271	20.9	1.1			29	30
		Rednet Room	Diffuser	1,250	75.7	29.6			375	375
	Zone - 018		VAV Box	1,094		30.5	55.0	87.0	338	338
		Office 32	Diffuser	247	16.1	29.6			74	74
		Office 33	Diffuser	440	23.0	29.6			132	132
		Office 34	Diffuser	440	23.0	29.6			132	132

ENERGY CONSUMPTION SUMMARY

By LANL

	Elect Cons. (kWh)	Oil Cons. (kBtu)	Water Cons. (1000 gals)	% of Total Building Energy	Total Building Energy (kBtu/yr)	Total Source Energy* (kBtu/yr)
Alternative 1						
Primary heating						
Primary heating		388,092		27.2 %	388,092	408,517
Other Htg Accessories	3,862		11	0.9 %	13,179	39,542
Heating Subtotal	**3,862**	**388,092**	**11**	**28.1 %**	**401,271**	**448,060**
Primary cooling						
Cooling Compressor	23,462			5.6 %	80,075	240,248
Tower/Cond Fans	1,820			0.4 %	6,210	18,632
Condenser Pump				0.0 %	0	0
Other Clg Accessories	876			0.2 %	2,990	8,970
Cooling Subtotal....	**26,157**			**6.3 %**	**89,274**	**267,850**
Auxiliary						
Supply Fans	72,984			17.5 %	249,095	747,361
Pumps	25,264			6.1 %	86,225	258,699
Stand-alone Base Utilities				0.0 %	0	0
Aux Subtotal....	98,248			23.5 %	335,320	1,006,060
Lighting						
Lighting	41,133			9.9 %	140,386	421,200
Receptacle						
Receptacles	134,651			32.2 %	459,562	1,378,824
Cogeneration						
Cogeneration				0.0 %	0	0
Totals						
Totals**	**304,050**	**388,092**	**11**	**100.0 %**	**1,425,813**	**3,521,994**

* Note: Resource Utilization factors are included in the Total Source Energy value .

** Note: This report can display a maximum of 7 utilities. If additional utilities are used, they will be included in the total.

MONTHLY ENERGY CONSUMPTION

By LANL

------- Monthly Energy Consumption -------

Utility		Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Total
Alternative: 1	**Modular Baseline**													
Electric														
	On-Pk Cons. (kWh)	22,052	20,246	24,449	22,630	28,566	33,340	29,460	31,025	24,635	24,016	22,219	21,411	304,050
	On-Pk Demand (kW)	104	103	107	117	155	177	171	158	142	113	102	102	177
Oil														
	Cons. (therms)	982	633	295	137	52	35	35	54	88	191	469	912	3,881
Water														
	Cons. (1000gal)	1	1	1	1	1	1	1	1	1	1	1	1	11

Energy Consumption		
Building	57,898	Btu/(ft2-year)
Source	143,019	Btu/(ft2-year)
Floor Area	24,626	ft2

Environmental Impact Analysis	
CO2	544,030 lbm/year
SO2	451 gm/year
NOX	1,215 gm/year

EQUIPMENT ENERGY CONSUMPTION

By LANL

Alternative: 1 Modular Baseline

Equipment - Utility	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Total
	------- Monthly Consumption -------												
Lights													
Electric (kWh)	3,414.2	3,089.0	3,739.3	3,251.6	3,576.8	3,576.8	3,251.6	3,739.3	3,251.6	3,576.8	3,414.2	3,251.6	41,132.7
Peak (kW)	25.5	25.5	25.5	25.5	25.5	25.5	25.5	25.5	25.5	25.5	25.5	25.5	25.5
Misc. Ld													
Electric (kWh)	6,814.9	6,165.8	7,461.8	6,490.7	7,138.3	7,137.6	6,491.5	7,461.8	6,490.7	7,138.3	6,814.2	6,491.5	82,097.0
Peak (kW)	31.8	31.8	31.8	31.8	31.8	31.8	31.8	31.8	31.8	31.8	31.8	31.8	31.8
IT Equipment Energy [PUE = 5.786, WUE = 0.779 L/kWh]													
Electric (kWh)	4,463.5	4,031.5	4,463.4	4,319.5	4,463.4	4,319.4	4,463.5	4,463.4	4,319.5	4,463.4	4,319.5	4,463.5	52,553.5
Peak (kW)	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Cooling Coil Condensate													
Recoverable Water (1000gal)	0.0	0.0	0.0	0.0	0.0	0.1	0.6	0.2	0.0	0.0	0.0	0.0	0.9
Peak (1000gal/Hr)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cpl 1: Cooling plant - 001 [Sum of dsn coil capacities=65.54 tons]													
Air-cooled chiller - 001 [Clg Nominal Capacity/F.L.Rate=65.54 tons / 77.87 kW] (Cooling Equipment)													
Electric (kWh)	336.8	304.2	442.7	720.5	3,219.3	6,605.9	4,790.6	3,896.5	1,926.8	555.9	325.9	336.8	23,461.6
Peak (kW)	5.6	5.6	12.4	19.4	53.2	70.3	66.7	56.1	40.1	14.6	5.8	5.6	70.3
90.1 Min Air Cooled Condenser [Design Heat Rejection/F.L.Rate=87.69 tons / 4.85 kW]													
Electric (kWh)	5.1	4.9	14.8	33.9	282.8	546.1	405.7	346.9	145.8	22.2	6.1	5.2	1,819.5
Peak (kW)	0.0	0.0	1.0	1.8	4.1	4.7	4.7	4.3	3.4	1.2	0.2	0.0	4.7
90.1 Min CV Chilled Water pump [F.L.Rate=2.88 kW] (Misc Accessory Equipment)													
Electric (kWh)	2,145.7	1,938.0	2,145.7	2,076.5	2,145.7	2,076.5	2,145.7	2,145.7	2,076.5	2,145.7	2,076.5	2,145.7	25,263.6
Peak (kW)	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9
Cntl panel & interlocks - 0.1 KW [F.L.Rate=0.10 kW] (Misc Accessory Equipment)													
Electric (kWh)	74.4	67.2	74.4	72.0	74.4	72.0	74.4	74.4	72.0	74.4	72.0	74.4	876.0
Peak (kW)	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Hpl 1: Heating plant - 002 [Sum of dsn coil capacities=688.9 mbh]													
Boiler - 001 [Nominal Capacity/F.L.Rate=688.9 mbh / 8.40 Therms] (Heating Equipment)													
Oil (therms)	981.7	632.7	294.6	136.8	51.7	34.7	34.9	53.7	88.2	191.5	468.8	911.6	3,880.9
Peak (therms/Hr)	8.4	8.4	5.3	2.5	1.2	0.4	0.4	0.4	1.6	2.9	6.8	8.4	8.4

EQUIPMENT ENERGY CONSUMPTION

By LANL

Alternative: 1 Modular Baseline

Equipment - Utility	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Total
	------- Monthly Consumption -------												
Hpl 1: Heating plant - 002 [Sum of dsn coil capacities=688.9 mbh]													
Fuel oil circulation pump [F.L.Rate=0.77 kW] (Misc Accessory Equipment)													
Electric (kWh)	195.0	176.4	213.5	185.7	204.2	204.2	185.7	210.4	185.7	204.2	195.0	185.7	2,345.5
Peak (kW)	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
Cntl panel & interlocks - 0.5 KW [F.L.Rate=0.50 kW] (Misc Accessory Equipment)													
Electric (kWh)	126.0	114.0	138.0	120.0	132.0	132.0	120.0	136.0	120.0	132.0	126.0	120.0	1,516.0
Peak (kW)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Make-up water - 5.18e-006 gal/btu (Misc Accessory Equipment)													
Make Up Water (1000gal)	0.9	0.8	1.0	0.9	0.9	0.9	0.9	1.0	0.9	0.9	0.9	0.9	10.8
Sys 1: Base System													
90.1-13 Min VAV AF Centrifugal [DsnAirflow/F.L.Rate=29,227 cfm / 22.37 kW] (Main Clg Fan)													
Electric (kWh)	2,354.5	2,316.7	3,010.3	2,796.0	3,763.1	4,439.4	3,860.7	4,401.9	3,116.6	2,961.6	2,573.1	2,279.2	37,872.9
Peak (kW)	16.6	16.9	19.0	21.6	22.4	22.4	22.4	22.4	22.4	20.5	17.4	15.5	22.4
90.1-13 Min VAV AF Centrifugal [DsnAirflow/F.L.Rate=33,642 cfm / 22.37 kW] (Main Return Fan)													
Electric (kWh)	1,851.4	1,817.4	2,362.1	2,195.6	2,955.9	3,499.5	3,038.1	3,461.1	2,446.9	2,325.4	2,021.5	1,791.1	29,765.9
Peak (kW)	13.1	13.3	14.9	16.9	18.0	18.4	17.8	17.7	17.9	16.1	13.7	12.1	18.4
90.1-13 Min VAV AF Centrifugal [DsnAirflow/F.L.Rate=29,227 cfm / 3.73 kW] (System Exhaust Fan)													
Electric (kWh)	270.4	221.5	382.9	368.2	610.2	730.9	633.0	688.2	483.3	415.7	275.2	266.2	5,345.5
Peak (kW)	1.9	2.2	3.2	3.6	3.7	3.7	3.7	3.7	3.7	3.4	2.9	2.1	3.7

SYSTEM LOAD PROFILES

By LANL

Modular Baseline
Base System

Percent Design Load	---- Cooling Load ---- Cap. (Tons)	Hours (%)	Hours	---- Heating Load ---- Cap. (Btuh)	Hours (%)	Hours	---- Cooling Airflow ---- Cap. (Cfm)	Hours (%)	Hours	---- Heating Airflow---- Cap. (Cfm)	Hours (%)	Hours
0 - 5	3.2	13	186	-34,443.1	54	1,628	1,461.4	6	294	0.0	0	0
5 - 10	6.5	14	205	-68,886.2	16	488	2,922.8	23	1,067	0.0	0	0
10 - 15	9.7	10	137	-103,329.4	7	198	4,384.2	0	8	0.0	0	0
15 - 20	12.9	5	65	-137,772.5	3	106	5,845.6	1	56	0.0	0	0
20 - 25	16.1	5	65	-172,215.6	0	11	7,307.0	3	142	0.0	0	0
25 - 30	19.3	6	81	-206,658.7	1	36	8,768.4	1	49	0.0	0	0
30 - 35	22.6	7	104	-241,101.9	1	38	10,229.8	0	0	0.0	0	0
35 - 40	25.8	8	117	-275,545.0	2	74	11,691.2	1	65	0.0	0	0
40 - 45	29.0	6	87	-309,988.1	5	146	13,152.6	0	22	0.0	0	0
45 - 50	32.2	4	58	-344,431.2	1	44	14,614.0	0	22	0.0	0	0
50 - 55	35.5	8	114	-378,874.3	0	11	16,075.4	1	58	0.0	0	0
55 - 60	38.7	3	41	-413,317.5	0	0	17,536.8	9	388	0.0	0	0
60 - 65	41.9	5	70	-447,760.6	1	40	18,998.2	9	425	0.0	0	0
65 - 70	45.1	0	0	-482,203.7	0	0	20,459.6	10	471	0.0	0	0
70 - 75	48.4	6	80	-516,646.8	1	24	21,921.0	12	525	0.0	0	0
75 - 80	51.6	2	26	-551,089.9	2	54	23,382.4	5	219	0.0	0	0
80 - 85	54.8	0	0	-585,533.1	1	23	24,843.8	7	315	0.0	0	0
85 - 90	58.0	0	0	-619,976.2	1	34	26,305.2	6	272	0.0	0	0
90 - 95	61.3	0	0	-654,419.3	0	3	27,766.6	1	47	0.0	0	0
95 - 100	64.5	0	0	-688,862.4	2	74	29,228.0	2	109	0.0	0	0
Hours Off	0.0	0	7,324	0.0	0	5,728	0.0	0	4,206	0.0	0	8,760

SYSTEM LOAD PROFILES

By LANL

Modular Baseline
System Totals

Percent Design Load	---- Cooling Load ---- Cap. (Tons)	Hours (%)	Hours	---- Heating Load ---- Cap. (Btuh)	Hours (%)	Hours	---- Cooling Airflow ---- Cap. (Cfm)	Hours (%)	Hours	---- Heating Airflow---- Cap. (Cfm)	Hours (%)	Hours
0 - 5	3.2	13	186	-34,443.1	54	1,628	1,461.4	6	294	0.0	0	0
5 - 10	6.5	14	205	-68,886.2	16	488	2,922.8	23	1,067	0.0	0	0
10 - 15	9.7	10	137	-103,329.4	7	198	4,384.2	0	8	0.0	0	0
15 - 20	12.9	5	65	-137,772.5	3	106	5,845.6	1	56	0.0	0	0
20 - 25	16.1	5	65	-172,215.6	0	11	7,307.0	3	142	0.0	0	0
25 - 30	19.3	6	81	-206,658.7	1	36	8,768.4	1	49	0.0	0	0
30 - 35	22.6	7	104	-241,101.9	1	38	10,229.8	0	0	0.0	0	0
35 - 40	25.8	8	117	-275,545.0	2	74	11,691.2	1	65	0.0	0	0
40 - 45	29.0	6	87	-309,988.1	5	146	13,152.6	0	22	0.0	0	0
45 - 50	32.2	4	58	-344,431.2	1	44	14,614.0	0	22	0.0	0	0
50 - 55	35.5	8	114	-378,874.3	0	11	16,075.4	1	58	0.0	0	0
55 - 60	38.7	3	41	-413,317.5	0	0	17,536.8	9	388	0.0	0	0
60 - 65	41.9	5	70	-447,760.6	1	40	18,998.2	9	425	0.0	0	0
65 - 70	45.1	0	0	-482,203.7	0	0	20,459.6	10	471	0.0	0	0
70 - 75	48.4	6	80	-516,646.8	1	24	21,921.0	12	525	0.0	0	0
75 - 80	51.6	2	26	-551,089.9	2	54	23,382.4	5	219	0.0	0	0
80 - 85	54.8	0	0	-585,533.1	1	23	24,843.8	7	315	0.0	0	0
85 - 90	58.0	0	0	-619,976.2	1	34	26,305.2	6	272	0.0	0	0
90 - 95	61.3	0	0	-654,419.3	0	3	27,766.6	1	47	0.0	0	0
95 - 100	64.5	0	0	-688,862.4	2	74	29,228.0	2	109	0.0	0	0
Hours Off	0.0	0	7,324	0.0	0	5,728	0.0	0	4,206	0.0	0	8,760

Load / Airflow Summary

By LANL

System	Zone	Room **		Floor Area ft²	People #	Coil Cooling Sensible Btu/h	Coil Cooling Total Btu/h	Space Design Max SA cfm	Air Changes ach/hr	VAV Minimum SA cfm	VAV Minimum %	Main Coil Heating Sensible Btu/h	Heating Fan Max SA cfm	Percent OA Clg	Percent OA Htg
Alternative 1															
		Office1	Rm Peak	775	12.0	24,559	30,258	1,917	14.84	575	30	-16,154	0	31.2	100.0
		Office2	Rm Peak	258	4.0	8,625	10,624	697	16.17	209	30	-5,802	0	29.6	100.0
		Office3	Rm Peak	871	12.0	25,543	31,269	1,716	11.81	515	30	-18,264	0	32.9	100.0
	Zone - 001		Zn Peak	846	28.0	30,520	37,540	4,329			14	-23,717	996	34.6	100.0
	Zone - 001		Zn Block	846	28.0	22,356	29,300	1,778			35	-13,179	996	34.6	100.0
		Office4	Rm Peak	258	4.0	8,625	10,624	697	16.17	209	30	-5,802	0	29.6	100.0
		Office5	Rm Peak	258	4.0	8,625	10,624	697	16.17	209	30	-5,802	0	29.6	100.0
		Office6	Rm Peak	258	4.0	7,309	9,010	524	12.16	157	30	-4,550	0	29.6	100.0
	Zone - 002		Zn Peak	775	12.0	24,559	30,258	1,917			30	-16,154	0	31.2	100.0
	Zone - 002		Zn Block	775	12.0	22,706	27,806	1,818			32	-16,154	0	31.2	100.0
		Office7	Rm Peak	258	4.0	7,309	9,010	524	12.16	157	30	-4,550	0	29.6	100.0
		Office8	Rm Peak	258	4.0	8,625	10,624	697	16.17	209	30	-5,802	0	29.6	100.0
		Office9	Rm Peak	355	4.0	10,067	12,093	495	8.38	149	30	-7,912	0	29.6	100.0
	Zone - 003		Zn Peak	871	12.0	25,543	31,269	1,716			30	-18,264	0	32.9	100.0
	Zone - 003		Zn Block	871	12.0	24,609	29,362	1,543			33	-18,264	0	32.9	100.0
		Office10	Rm Peak	355	4.0	9,909	11,981	739	12.50	222	30	-6,464	0	29.6	100.0
		Office11	Rm Peak	355	4.0	16,529	19,256	1,120	18.94	336	30	-11,296	0	29.6	100.0
		Office12	Rm Peak	258	4.0	8,625	10,624	697	16.17	209	30	-5,802	0	29.6	100.0
		Workspace 1	Rm Peak	1,064	8.0	13,880	16,654	682	3.85	205	30	-4,204	0	29.6	100.0
	Zone - 004		Zn Peak	258	20.0	36,880	41,781	3,237			5	-892	927	4.9	4.6
	Zone - 004		Zn Block	258	20.0	39,174	47,746	2,735			36	-19,505	927	4.9	4.6
		Office13	Rm Peak	258	20.0	36,880	41,781	3,135	9.26	157	5	-892	927	4.9	4.6
		Office14	Rm Peak	258	4.0	7,309	9,010	524	12.16	157	30	-4,550	0	29.6	100.0
		Office15	Rm Peak	258	4.0	8,625	10,624	697	16.17	209	30	-5,802	0	29.6	100.0
	Zone - 005		Zn Peak	258	28.0	47,615	54,116	4,356			4	-873	1,293	3.6	3.3
	Zone - 005		Zn Block	258	28.0	63,649	68,450	3,135			17	-7,618	1,293	3.6	3.3
		Office16	Rm Peak	258	4.0	8,625	10,624	697	16.17	209	30	-5,802	0	29.6	100.0
		Office17	Rm Peak	258	28.0	47,615	54,116	4,290	10.10	157	4	-873	1,293	3.6	3.3
		Office18	Rm Peak	258	4.0	8,625	10,624	697	16.17	209	30	-5,802	0	29.6	100.0
	Zone - 006		Zn Peak	262	36.0	60,221	68,910	5,683			5	-885	1,711	4.5	2.5
	Zone - 006		Zn Block	262	36.0	85,942	91,041	4,290			13	-8,580	1,711	4.5	2.5
		Office19	Rm Peak	329	4.0	10,956	13,085	772	14.06	232	30	-7,734	0	29.6	100.0
		Office20	Rm Peak	416	4.0	18,785	22,306	1,100	15.87	330	30	-10,530	0	29.6	100.0
		Office21	Rm Peak	262	36.0	60,221	68,910	5,632	11.02	260	5	-885	1,711	4.5	2.5
		Printer Area 2	Rm Peak	63	0.6	977	1,158	43	4.13	43	100	-650	0	29.6	100.0

*** This report does not display heating only systems.**

System	Zone	Room **		Floor Area ft²	People #	Coil Cooling Sensible Btu/h	Coil Cooling Total Btu/h	Space Design Max SA cfm	Air Changes ach/hr	VAV Minimum SA cfm	VAV Minimum %	Main Coil Heating Sensible Btu/h	Heating Fan Max SA cfm	Percent OA Clg	Percent OA Htg
		Workspace 2b	Rm Peak	329	8.0	6,387	8,518	308	5.63	93	30	-1,784	0	29.6	100.0
	Zone - 007		Zn Peak	242	52.6	85,858	97,601	7,856			3	-837	2,409	2.8	1.8
	Zone - 007		Zn Block	242	52.6	114,456	125,154	5,632			17	-13,538	2,409	2.8	1.8
		Office22	Rm Peak	253	4.0	18,022	21,508	1,086	25.74	326	30	-10,312	0	29.6	100.0
		Office23	Rm Peak	242	4.0	15,510	17,288	737	18.31	221	30	-6,052	0	29.6	100.0
		Office24	Rm Peak	242	4.0	11,019	12,501	514	12.76	154	30	-4,494	0	29.6	100.0
		Office25	Rm Peak	242	52.6	85,858	97,601	7,737	11.05	221	3	-837	2,409	2.8	1.8
	Zone - 008		Zn Peak	242	64.6	118,989	133,135	10,073			2	-824	3,110	1.5	1.4
	Zone - 008		Zn Block	242	64.6	153,773	160,253	7,737			12	-13,127	3,110	1.5	1.4
		Break Room1	Rm Peak	714	47.6	25,764	34,701	1,389	11.68	417	30	-6,211	0	29.6	100.0
		Conference Room1	Rm Peak	714	35.7	29,194	36,417	1,577	13.26	473	30	-13,408	0	29.6	100.0
		Reception Area	Rm Peak	266	15.9	9,509	12,254	511	11.52	153	30	-3,907	0	29.6	100.0
	Zone - 009		Zn Peak	416	99.2	53,442	67,005	3,478			8	-851	987	7.9	5.4
	Zone - 009		Zn Block	416	99.2	52,573	66,117	2,945			35	-15,803	987	7.9	5.4
		Office26	Rm Peak	242	4.0	15,510	17,288	737	18.31	221	30	-6,052	0	29.6	100.0
		Office27	Rm Peak	242	64.6	118,989	133,135	9,900	12.03	154	2	-824	3,110	1.5	1.4
		Office28	Rm Peak	242	4.0	15,510	17,288	737	18.31	221	30	-6,052	0	29.6	100.0
	Zone - 010		Zn Peak	250	72.6	141,498	156,054	11,373			0	-558	3,565	0.2	0.5
	Zone - 010		Zn Block	250	72.6	192,221	196,659	9,900			6	-8,205	3,565	0.2	0.5
		Office29	Rm Peak	253	4.0	18,405	20,375	882	20.91	264	30	-9,298	0	29.6	100.0
		Office30	Rm Peak	262	4.0	16,130	17,945	764	17.50	229	30	-6,291	0	29.6	100.0
		Office31	Rm Peak	416	99.2	53,442	67,005	3,338	11.82	269	8	-851	987	7.9	5.4
	Zone - 011		Zn Peak	131	107.2	75,966	88,956	4,983			1	-468	1,507	0.2	0.6
	Zone - 011		Zn Block	131	107.2	69,043	74,218	3,338			23	-11,542	1,507	0.2	0.6
		Corridor 1	Rm Peak	2,940	20.6	15,021	19,474	676	1.38	220	33	-5,898	0	29.6	100.0
		Corridor 2	Rm Peak	2,321	16.2	12,205	15,728	538	1.39	174	32	-5,874	0	29.6	100.0
		Corridor 3a	Rm Peak	285	2.0	1,534	1,973	70	1.47	21	31	-572	0	29.6	100.0
		Corridor 3b	Rm Peak	250	72.6	141,498	156,054	11,176	12.37	30	0	-558	3,565	0.2	0.5
		Corridor 3c	Rm Peak	250	1.7	1,345	1,730	61	1.47	19	31	-501	0	29.6	100.0
		Corridor 3d	Rm Peak	285	2.0	1,534	1,973	70	1.47	21	31	-572	0	29.6	100.0
		Corridor 4a	Rm Peak	131	0.9	713	916	33	1.49	10	30	-263	0	29.6	100.0
		Corridor 4b	Rm Peak	131	107.2	75,966	88,956	4,710	12.79	30	1	-468	1,507	0.2	0.6
		Entrance Vestibule	Rm Peak	196	1.4	27,138	28,794	1,159	35.49	348	30	-11,764	0	29.6	100.0
		North Stairwell	Rm Peak	390	2.7	7,196	8,452	375	5.76	113	30	-7,652	0	29.6	100.0
		South Stairwell	Rm Peak	390	2.7	8,531	10,030	473	7.27	142	30	-8,140	0	29.6	100.0
	Zone - 012		Zn Peak	60	230.1	269,058	304,152	19,341			0	-512	6,171	0.0	0.1
	Zone - 012		Zn Block	60	230.1	222,559	236,103	11,176			10	-19,560	6,171	0.0	0.1
		Conference Room 2	Rm Peak	820	41.0	18,275	25,023	966	7.07	318	33	-4,842	0	29.6	100.0
		Printer Area 1	Rm Peak	63	0.6	977	1,158	43	4.13	43	100	-650	0	29.6	100.0
		Workspace 2a	Rm Peak	329	8.0	6,387	8,518	308	5.63	93	30	-1,784	0	29.6	100.0
		Workspace 3	Rm Peak	250	4.0	4,109	5,255	201	4.83	60	30	-1,190	0	29.6	100.0

*** This report does not display heating only systems.**

System	Zone Room **		Floor Area ft²	People #	Coil Cooling Sensible Btu/h	Coil Cooling Total Btu/h	Space Design Max SA cfm	Air Changes ach/hr	VAV Minimum SA cfm	VAV Minimum %	Main Coil Heating Sensible Btu/h	Heating Fan Max SA cfm	Percent OA Clg	Percent OA Htg
	Zone - 013	Zn Peak	61	53.6	24,433	32,019	1,518			2	-425	486	0.3	0.9
	Zone - 013	Zn Block	61	53.6	22,748	31,051	1,182			43	-7,934	486	0.3	0.9
	Equipment Room	Rm Peak	152	0.0	3,362	3,696	135	5.33	41	30	-2,558	0	29.6	100.0
	Small Mechanical Room	Rm Peak	219	0.0	49,867	55,010	2,079	56.89	624	30	-9,293	0	29.6	100.0
	Storage Room	Rm Peak	280	0.0	2,074	2,243	68	1.46	21	31	-349	0	29.6	100.0
	Zone - 014	Zn Peak	99	0.0	49,005	49,218	2,282			1	-447	655	1.1	3.8
	Zone - 014	Zn Block	99	0.0	53,399	59,045	2,229			31	-10,210	655	1.1	3.8
	Janitor Closet	Rm Peak	70	0.0	522	564	17	1.46	5	31	-87	0	29.6	100.0
	Mens Restroom	Rm Peak	539	6.0	3,579	4,187	152	1.69	46	30	-680	0	29.6	100.0
	Printer Area 3	Rm Peak	90	0.9	1,403	1,664	62	4.13	62	100	-934	0	29.6	100.0
	Storage Area 2	Rm Peak	60	230.1	269,058	304,152	18,837	7.63	30	0	-512	6,171	0.0	0.1
	Womens Restroom	Rm Peak	539	6.0	3,579	4,187	152	1.69	46	30	-680	0	29.6	100.0
	Zone - 015	Zn Peak	1,298	243.0	543,777	580,391	19,220			1	-2,892	6,171	0.6	2.6
	Zone - 015	Zn Block	1,298	243.0	361,568	362,880	18,837			1	-3,075	6,171	0.6	2.6
	Electrical Equipment Room	Rm Peak	236	0.0	1,749	1,892	58	1.46	18	31	-294	0	29.6	100.0
	Fire Riser Room	Rm Peak	61	53.6	24,433	32,019	1,498	6.15	30	2	-425	486	0.3	0.9
	Large Mechanical Room	Rm Peak	774	0.0	53,700	59,163	2,208	17.11	662	30	-9,871	0	29.6	100.0
	Storage Room 2	Rm Peak	61	0.0	537	575	15	1.46	5	31	-77	0	29.6	100.0
	Zone - 016	Zn Peak	1,133	53.6	80,434	93,662	3,779			19	-10,667	486	28.7	57.5
	Zone - 016	Zn Block	1,133	53.6	55,515	61,194	2,367			30	-10,765	486	28.7	57.5
	Communications Room	Rm Peak	192	4.8	3,162	4,218	167	5.23	50	30	-979	0	29.6	100.0
	Network Room	Rm Peak	99	0.0	49,005	49,218	2,271	20.92	30	1	-447	655	1.1	3.8
	Rednet Room	Rm Peak	99	0.0	29,867	32,959	1,250	75.74	375	30	-5,587	0	29.6	100.0
	Zone - 017	Zn Peak	390	7.3	97,210	101,572	3,688			12	-7,013	655	19.6	40.6
	Zone - 017	Zn Block	390	7.3	52,572	56,946	2,271			20	-12,292	655	19.6	40.6
	Office 32	Rm Peak	92	2.0	5,382	6,110	247	16.11	74	30	-2,192	0	29.6	100.0
	Office 33	Rm Peak	115	2.0	9,399	10,412	440	22.96	132	30	-3,866	0	29.6	100.0
	Office 34	Rm Peak	115	2.0	9,399	10,412	440	22.96	132	30	-3,866	0	29.6	100.0
	Zone - 018	Zn Peak	322	6.0	24,098	26,852	1,127			30	-9,924	0	30.5	100.0
	Zone - 018	Zn Block	322	6.0	23,528	25,998	1,094			31	-9,924	0	30.5	100.0
Base System		**Sys Peak**	**24,626**	**1,123.6**	**1,646,210**	**1,896,632**	**109,955**				**-299,217**	**23,817**	**40.0**	**31.9**
Base System		**Sys Block**	**24,626**	**1,123.6**	**638,879**	**773,738**	**29,228**				**-205,851**	**23,817**	**40.0**	**31.9**

*** This report does not display heating only systems.**

BUILDING AREAS
By LANL

Sys	Zon	Room	Number of Duplicate Floors	Number of Duplicate Rooms	Floor Area/ Duplicate Room ft²	Total Floor Area ft²	Partition Area ft²	Int Door Area ft²	Exposed Floor Area ft²	Skylight Area ft²	Net Roof Area ft²	Window Area ft²	Window/ Wall %	Ext Door Area ft²	Net Wall Area ft²
Alternative 1															
		Office1	2	1	388	775	0	0	31	0	388	162	22	0	573
		Office2	2	1	129	258	0	0	10	0	129	61	25	0	184
		Office3	2	1	436	871	0	0	47	0	436	237	21	0	893
	Zone - 001					846	0	0	46	0	423	155	14	0	951
		Office4	2	1	129	258	0	0	10	0	129	61	25	0	184
		Office5	2	1	129	258	0	0	10	0	129	61	25	0	184
		Office6	2	1	129	258	0	0	10	0	129	39	16	0	206
	Zone - 002					775	0	0	31	0	388	162	22	0	573
		Office7	2	1	129	258	0	0	10	0	129	39	16	0	206
		Office8	2	1	129	258	0	0	10	0	129	61	25	0	184
		Office9	2	1	177	355	0	0	27	0	177	136	21	0	504
	Zone - 003					871	0	0	47	0	436	237	21	0	893
		Office10	2	1	177	355	0	0	14	0	177	60	18	0	276
		Office11	2	1	177	355	0	0	28	0	177	144	21	0	528
		Office12	2	1	129	258	0	0	10	0	129	61	25	0	184
		Workspace 1	2	1	532	1,064	0	0	0	0	532	0	0	0	0
	Zone - 004					258	0	0	10	0	129	39	16	0	206
		Office13	2	1	129	258	0	0	10	0	129	39	16	0	206
		Office14	2	1	129	258	0	0	10	0	129	39	16	0	206
		Office15	2	1	129	258	0	0	10	0	129	61	25	0	184
	Zone - 005					258	0	0	10	0	129	39	16	0	206
		Office16	2	1	129	258	0	0	10	0	129	61	25	0	184
		Office17	2	1	129	258	0	0	10	0	129	39	16	0	206
		Office18	2	1	129	258	0	0	10	0	129	61	25	0	184
	Zone - 006					262	0	0	13	0	131	76	25	0	228
		Office19	2	1	165	329	0	0	26	0	165	56	9	0	560
		Office20	2	1	208	416	0	0	24	0	208	128	22	0	446
		Office21	2	1	131	262	0	0	13	0	131	76	25	0	228
		Workspace 2b	2	1	164	329	0	0	0	0	164	0	0	0	0
		Printer Area 2	2	1	31	63	0	0	0	0	31	0	0	0	0
	Zone - 007					242	0	0	11	0	121	63	25	0	189
		Office22	2	1	127	253	0	0	23	0	127	135	25	0	405
		Office23	2	1	121	242	0	0	11	0	121	63	25	0	189
		Office24	2	1	121	242	0	0	11	0	121	38	15	0	214
		Office25	2	1	121	242	0	0	11	0	121	63	25	0	189
	Zone - 008					242	0	0	11	0	121	38	15	0	214
		Conference Room1	2	1	357	714	0	0	39	0	357	137	15	0	799
		Reception Area	1	1	266	266	0	0	10	0	0	29	25	0	86
		Break Room1	2	1	357	714	0	0	39	0	357	137	15	0	799

BUILDING AREAS
By LANL

Sys	Zon	Room	Number of Duplicate Floors	Number of Duplicate Rooms	Floor Area/ Duplicate Room ft²	Total Floor Area ft²	Partition Area ft²	Int Door Area ft²	Exposed Floor Area ft²	Skylight Area ft²	Net Roof Area ft²	Window Area ft²	Window/ Wall %	Ext Door Area ft²	Net Wall Area ft²
	Zone - 009					416	0	0	24	0	208	128	22	0	446
		Office26	2	1	121	242	0	0	11	0	121	63	25	0	189
		Office27	2	1	121	242	0	0	11	0	121	38	15	0	214
		Office28	2	1	121	242	0	0	11	0	121	63	25	0	189
	Zone - 010					250	0	0	0	0	125	0	0	0	0
		Office29	2	1	127	253	0	0	23	0	127	135	25	0	405
		Office30	2	1	131	262	0	0	11	0	131	66	25	0	197
		Office31	2	1	208	416	0	0	24	0	208	128	22	0	446
	Zone - 011					131	0	0	0	0	66	0	0	0	0
		Corridor 1	2	1	1,470	2,940	0	0	0	0	1,470	0	0	0	0
		Corridor 2	2	1	1,161	2,321	0	0	12	0	1,161	0	0	0	283
		Corridor 3a	2	1	143	285	0	0	0	0	143	0	0	0	0
		Corridor 3b	2	1	125	250	0	0	0	0	125	0	0	0	0
		Corridor 3d	2	1	143	285	0	0	0	0	143	0	0	0	0
		Corridor 3c	2	1	125	250	0	0	0	0	125	0	0	0	0
		Corridor 4a	2	1	66	131	0	0	0	0	66	0	0	0	0
		Corridor 4b	2	1	66	131	0	0	0	0	66	0	0	0	0
		Entrance Vestibule	1	1	196	196	0	0	28	0	0	144	55	72	120
		North Stairwell	2	1	195	390	0	0	40	0	195	48	5	56	846
		South Stairwell	2	1	195	390	0	0	40	0	195	48	5	56	846
	Zone - 012					60	0	0	0	0	30	0	0	0	0
		Conference Room 2	2	1	410	820	0	0	0	0	410	0	0	0	0
		Workspace 2a	2	1	164	329	0	0	0	0	164	0	0	0	0
		Workspace 3	2	1	125	250	0	0	0	0	125	0	0	0	0
		Printer Area 1	2	1	31	63	0	0	0	0	31	0	0	0	0
	Zone - 013					61	0	0	0	0	0	0	0	0	0
		Equipment Room	2	1	76	152	0	0	10	0	76	57	25	0	171
		Storage Room	2	1	140	280	0	0	0	0	140	0	0	0	0
		Small Mechanical Room	2	1	110	219	0	0	0	0	110	0	0	0	0
	Zone - 014					99	0	0	0	0	99	0	0	0	0
		Janitor Closet	2	1	35	70	0	0	0	0	35	0	0	0	0
		Storage Area 2	2	1	30	60	0	0	0	0	30	0	0	0	0
		Mens Restroom	2	1	269	539	0	0	0	0	269	0	0	0	0
		Womens Restroom	2	1	269	539	0	0	0	0	269	0	0	0	0
		Printer Area 3	2	1	45	90	0	0	0	0	45	0	0	0	0
	Zone - 015					1,298	0	0	0	0	649	0	0	0	0
		Large Mechanical Room	2	1	387	774	0	0	0	0	387	0	0	0	0
		Fire Riser Room	1	1	61	61	0	0	0	0	0	0	0	0	0
		Storage Room 2	1	1	61	61	0	0	0	0	61	0	0	0	0
		Electrical Equipment Room	2	1	118	236	0	0	0	0	118	0	0	0	0
	Zone - 016					1,133	0	0	0	0	567	0	0	0	0

BUILDING AREAS
By LANL

Sys	Zon	Room	Number of Duplicate Floors	Number of Duplicate Rooms	Floor Area/ Duplicate Room ft²	Total Floor Area ft²	Partition Area ft²	Int Door Area ft²	Exposed Floor Area ft²	Skylight Area ft²	Net Roof Area ft²	Window Area ft²	Window/ Wall %	Ext Door Area ft²	Net Wall Area ft²
		Rednet Room	1	1	99	99	0	0	0	0	0	0	0	0	0
		Network Room	1	1	99	99	0	0	0	0	99	0	0	0	0
		Communications Room	2	1	96	192	0	0	0	0	96	0	0	0	0
	Zone - 017					390	0	0	0	0	195	0	0	0	0
		Office 32	1	1	92	92	0	0	8	0	92	19	20	0	77
		Office 33	1	1	115	115	0	0	13	0	115	39	25	0	117
		Office 34	1	1	115	115	0	0	13	0	115	39	25	0	117
	Zone - 018					322	0	0	34	0	322	97	24	0	311
Base System						24,626	0	0	692	0	12,243	2,867	18	184	12,703

Total building Window Area: 2,867 ft²

Total building Wall Area: 15,754 ft²

Building Total Window %: 18.2%

Total building Skylight Area: 0 ft²

Total building Roof Area: 12,243 ft²

Building Total Skylight %: 0.0%

Total building Floor Area: 24,626 ft²

BUILDING U-FACTORS

By LANL

Description	ROOM U-FACTORS Btu/h·ft²·°F Partition	Internal Door	Exposed Floor	Summer Skylight	Winter Skylight	Roof	Summer Window	Winter Window	External Door	Wall	Ceiling	Room Mass lb/ft²	Room Capacitance Btu/lb·°F
Alternative 1													
Office1	0.000	0.000	0.520	0.000	0.000	0.032	0.314	0.308	0.000	0.051	0.317	34.7	7.4
Office2	0.000	0.000	0.520	0.000	0.000	0.032	0.314	0.308	0.000	0.051	0.317	34.3	7.3
Office3	0.000	0.000	0.520	0.000	0.000	0.032	0.314	0.308	0.000	0.051	0.317	39.6	8.4
Zone - 001 - Zone	0.000	0.000	0.520	0.000	0.000	0.032	0.314	0.308	0.000	0.051	0.317	41.2	8.7
Office4	0.000	0.000	0.520	0.000	0.000	0.032	0.314	0.308	0.000	0.051	0.317	34.3	7.3
Office5	0.000	0.000	0.520	0.000	0.000	0.032	0.314	0.308	0.000	0.051	0.317	34.3	7.3
Office6	0.000	0.000	0.520	0.000	0.000	0.032	0.314	0.308	0.000	0.051	0.317	35.7	7.6
Zone - 002 - Zone	0.000	0.000	0.520	0.000	0.000	0.032	0.314	0.308	0.000	0.051	0.317	34.7	7.4
Office7	0.000	0.000	0.520	0.000	0.000	0.032	0.314	0.308	0.000	0.051	0.317	35.7	7.6
Office8	0.000	0.000	0.520	0.000	0.000	0.032	0.314	0.308	0.000	0.051	0.317	34.3	7.3
Office9	0.000	0.000	0.520	0.000	0.000	0.032	0.314	0.308	0.000	0.051	0.317	46.3	9.7
Zone - 003 - Zone	0.000	0.000	0.520	0.000	0.000	0.032	0.314	0.308	0.000	0.051	0.317	39.6	8.4
Office10	0.000	0.000	0.520	0.000	0.000	0.032	0.314	0.308	0.000	0.051	0.317	35.4	7.5
Office11	0.000	0.000	0.520	0.000	0.000	0.032	0.314	0.308	0.000	0.051	0.317	47.4	9.9
Office12	0.000	0.000	0.520	0.000	0.000	0.032	0.314	0.308	0.000	0.051	0.317	34.3	7.3
Workspace 1	0.000	0.000	0.000	0.000	0.000	0.032	0.000	0.000	0.000	0.000	0.317	22.2	4.9
Zone - 004 - Zone	0.000	0.000	0.520	0.000	0.000	0.032	0.314	0.308	0.000	0.051	0.317	35.7	7.6
Office13	0.000	0.000	0.520	0.000	0.000	0.032	0.314	0.308	0.000	0.051	0.317	35.7	7.6
Office14	0.000	0.000	0.520	0.000	0.000	0.032	0.314	0.308	0.000	0.051	0.317	35.7	7.6
Office15	0.000	0.000	0.520	0.000	0.000	0.032	0.314	0.308	0.000	0.051	0.317	34.3	7.3
Zone - 005 - Zone	0.000	0.000	0.520	0.000	0.000	0.032	0.314	0.308	0.000	0.051	0.317	35.7	7.6
Office16	0.000	0.000	0.520	0.000	0.000	0.032	0.314	0.308	0.000	0.051	0.317	34.3	7.3
Office17	0.000	0.000	0.520	0.000	0.000	0.032	0.314	0.308	0.000	0.051	0.317	35.7	7.6
Office18	0.000	0.000	0.520	0.000	0.000	0.032	0.314	0.308	0.000	0.051	0.317	34.3	7.3
Zone - 006 - Zone	0.000	0.000	0.520	0.000	0.000	0.032	0.314	0.308	0.000	0.051	0.317	37.0	7.8
Office19	0.000	0.000	0.520	0.000	0.000	0.032	0.314	0.308	0.000	0.051	0.317	51.0	10.6
Office20	0.000	0.000	0.520	0.000	0.000	0.032	0.314	0.308	0.000	0.051	0.317	40.4	8.5
Office21	0.000	0.000	0.520	0.000	0.000	0.032	0.314	0.308	0.000	0.051	0.317	37.0	7.8
Workspace 2b	0.000	0.000	0.000	0.000	0.000	0.032	0.000	0.000	0.000	0.000	0.317	22.2	4.9
Printer Area 2	0.000	0.000	0.000	0.000	0.000	0.032	0.000	0.000	0.000	0.000	0.317	22.2	4.9
Zone - 007 - Zone	0.000	0.000	0.520	0.000	0.000	0.032	0.314	0.308	0.000	0.051	0.317	35.5	7.5

BUILDING U-FACTORS

By LANL

Description	ROOM U-FACTORS Btu/h·ft²·°F Partition	Internal Door	Exposed Floor	Summer Skylight	Winter Skylight	Roof	Summer Window	Winter Window	External Door	Wall	Ceiling	Room Mass lb/ft²	Room Capacitance Btu/lb·°F
Office22	0.000	0.000	0.520	0.000	0.000	0.032	0.314	0.308	0.000	0.051	0.317	49.3	10.3
Office23	0.000	0.000	0.520	0.000	0.000	0.032	0.314	0.308	0.000	0.051	0.317	35.5	7.5
Office24	0.000	0.000	0.520	0.000	0.000	0.032	0.314	0.308	0.000	0.051	0.317	37.2	7.9
Office25	0.000	0.000	0.520	0.000	0.000	0.032	0.314	0.308	0.000	0.051	0.317	35.5	7.5
Zone - 008 - Zone	0.000	0.000	0.520	0.000	0.000	0.032	0.314	0.308	0.000	0.051	0.317	37.2	7.9
Conference Room1	0.000	0.000	0.520	0.000	0.000	0.032	0.314	0.308	0.000	0.051	0.317	41.2	8.7
Reception Area	0.000	0.000	0.520	0.000	0.000	0.000	0.314	0.308	0.000	0.051	0.317	18.8	3.8
Break Room1	0.000	0.000	0.520	0.000	0.000	0.032	0.314	0.308	0.000	0.051	0.317	41.2	8.7
Zone - 009 - Zone	0.000	0.000	0.520	0.000	0.000	0.032	0.314	0.308	0.000	0.051	0.317	40.4	8.5
Office26	0.000	0.000	0.520	0.000	0.000	0.032	0.314	0.308	0.000	0.051	0.317	35.5	7.5
Office27	0.000	0.000	0.520	0.000	0.000	0.032	0.314	0.308	0.000	0.051	0.317	37.2	7.9
Office28	0.000	0.000	0.520	0.000	0.000	0.032	0.314	0.308	0.000	0.051	0.317	35.5	7.5
Zone - 010 - Zone	0.000	0.000	0.000	0.000	0.000	0.032	0.000	0.000	0.000	0.000	0.317	22.2	4.9
Office29	0.000	0.000	0.520	0.000	0.000	0.032	0.314	0.308	0.000	0.051	0.317	49.3	10.3
Office30	0.000	0.000	0.520	0.000	0.000	0.032	0.314	0.308	0.000	0.051	0.317	34.9	7.4
Office31	0.000	0.000	0.520	0.000	0.000	0.032	0.314	0.308	0.000	0.051	0.317	40.4	8.5
Zone - 011 - Zone	0.000	0.000	0.000	0.000	0.000	0.032	0.000	0.000	0.000	0.000	0.317	22.2	4.9
Corridor 1	0.000	0.000	0.000	0.000	0.000	0.032	0.000	0.000	0.000	0.000	0.317	22.2	4.9
Corridor 2	0.000	0.000	0.520	0.000	0.000	0.032	0.000	0.000	0.000	0.051	0.317	24.3	5.3
Corridor 3a	0.000	0.000	0.000	0.000	0.000	0.032	0.000	0.000	0.000	0.000	0.317	22.2	4.9
Corridor 3b	0.000	0.000	0.000	0.000	0.000	0.032	0.000	0.000	0.000	0.000	0.317	22.2	4.9
Corridor 3d	0.000	0.000	0.000	0.000	0.000	0.032	0.000	0.000	0.000	0.000	0.317	22.2	4.9
Corridor 3c	0.000	0.000	0.000	0.000	0.000	0.032	0.000	0.000	0.000	0.000	0.317	22.2	4.9
Corridor 4a	0.000	0.000	0.000	0.000	0.000	0.032	0.000	0.000	0.000	0.000	0.317	22.2	4.9
Corridor 4b	0.000	0.000	0.000	0.000	0.000	0.032	0.000	0.000	0.000	0.000	0.317	22.2	4.9
Entrance Vestibule	0.000	0.000	0.520	0.000	0.000	0.000	0.314	0.308	0.500	0.051	0.317	19.5	4.1
North Stairwell	0.000	0.000	0.520	0.000	0.000	0.032	0.314	0.308	0.200	0.051	0.317	58.9	12.2
South Stairwell	0.000	0.000	0.520	0.000	0.000	0.032	0.314	0.308	0.200	0.051	0.317	58.9	12.2
Zone - 012 - Zone	0.000	0.000	0.000	0.000	0.000	0.032	0.000	0.000	0.000	0.000	0.317	22.2	4.9
Conference Room 2	0.000	0.000	0.000	0.000	0.000	0.032	0.000	0.000	0.000	0.000	0.317	22.2	4.9
Workspace 2a	0.000	0.000	0.000	0.000	0.000	0.032	0.000	0.000	0.000	0.000	0.317	22.2	4.9
Workspace 3	0.000	0.000	0.000	0.000	0.000	0.032	0.000	0.000	0.000	0.000	0.317	22.2	4.9

BUILDING U-FACTORS

By LANL

Description	ROOM U-FACTORS Btu/h·ft²·°F Partition	Internal Door	Exposed Floor	Summer Skylight	Winter Skylight	Roof	Summer Window	Winter Window	External Door	Wall	Ceiling	Room Mass lb/ft²	Room Capacitance Btu/lb·°F
Printer Area 1	0.000	0.000	0.000	0.000	0.000	0.032	0.000	0.000	0.000	0.000	0.317	22.2	4.9
Zone - 013 - Zone	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.317	13.3	2.7
Equipment Room	0.000	0.000	0.520	0.000	0.000	0.032	0.314	0.308	0.000	0.051	0.317	41.3	8.7
Storage Room	0.000	0.000	0.000	0.000	0.000	0.032	0.000	0.000	0.000	0.000	0.317	22.2	4.9
Small Mechanical Room	0.000	0.000	0.000	0.000	0.000	0.032	0.000	0.000	0.000	0.000	0.317	22.2	4.9
Zone - 014 - Zone	0.000	0.000	0.000	0.000	0.000	0.032	0.000	0.000	0.000	0.000	0.317	31.1	7.1
Janitor Closet	0.000	0.000	0.000	0.000	0.000	0.032	0.000	0.000	0.000	0.000	0.317	22.2	4.9
Storage Area 2	0.000	0.000	0.000	0.000	0.000	0.032	0.000	0.000	0.000	0.000	0.317	22.2	4.9
Mens Restroom	0.000	0.000	0.000	0.000	0.000	0.032	0.000	0.000	0.000	0.000	0.317	22.2	4.9
Womens Restroom	0.000	0.000	0.000	0.000	0.000	0.032	0.000	0.000	0.000	0.000	0.317	22.2	4.9
Printer Area 3	0.000	0.000	0.000	0.000	0.000	0.032	0.000	0.000	0.000	0.000	0.317	22.2	4.9
Zone - 015 - Zone	0.000	0.000	0.000	0.000	0.000	0.032	0.000	0.000	0.000	0.000	0.317	22.2	4.9
Large Mechanical Room	0.000	0.000	0.000	0.000	0.000	0.032	0.000	0.000	0.000	0.000	0.317	22.2	4.9
Fire Riser Room	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.317	13.3	2.7
Storage Room 2	0.000	0.000	0.000	0.000	0.000	0.032	0.000	0.000	0.000	0.000	0.317	31.1	7.1
Electrical Equipment Room	0.000	0.000	0.000	0.000	0.000	0.032	0.000	0.000	0.000	0.000	0.317	22.2	4.9
Zone - 016 - Zone	0.000	0.000	0.000	0.000	0.000	0.032	0.000	0.000	0.000	0.000	0.317	22.2	4.9
Rednet Room	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.317	13.3	2.7
Network Room	0.000	0.000	0.000	0.000	0.000	0.032	0.000	0.000	0.000	0.000	0.317	31.1	7.1
Communications Room	0.000	0.000	0.000	0.000	0.000	0.032	0.000	0.000	0.000	0.000	0.317	22.2	4.9
Zone - 017 - Zone	0.000	0.000	0.000	0.000	0.000	0.032	0.000	0.000	0.000	0.000	0.317	22.2	4.9
Office 32	0.000	0.000	0.520	0.000	0.000	0.032	0.314	0.308	0.000	0.051	0.317	45.3	9.9
Office 33	0.000	0.000	0.520	0.000	0.000	0.032	0.314	0.308	0.000	0.051	0.317	48.4	10.6
Office 34	0.000	0.000	0.520	0.000	0.000	0.032	0.314	0.308	0.000	0.051	0.317	48.4	10.6
Zone - 018 - Zone	0.000	0.000	0.520	0.000	0.000	0.032	0.314	0.308	0.000	0.051	0.317	47.5	10.4
Base System - System	0.000	0.000	0.520	0.000	0.000	0.032	0.314	0.308	0.317	0.051	0.317	30.9	6.6

BUILDING U-FACTORS

By LANL

Description	ROOM U-FACTORS Btu/h·ft²·°F											Room Mass lb/ft²	Room Capacitance Btu/lb·°F
	Partition	Internal Door	Exposed Floor	Summer Skylight	Winter Skylight	Roof	Summer Window	Winter Window	External Door	Wall	Ceiling		

Overall U-Factors			Overall Thermal Transfer Values		
Roof	0.032	Btu/h·ft²·°F	**Roof (OTTVr)**	1.16	Btu/hr·ft²
Wall	0.102	Btu/h·ft²·°F	**Wall (OTTVw)**	16.77	Btu/hr·ft²
Building	0.071	Btu/h·ft²·°F			