Technical Report Three

Mechanical Systems Existing Conditions Report

Defense Information Systems Agency Headquarters Facility

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Executive Summary

The objective of this report is to summarize the designed mechanical systems currently being installed in the DISA Headquarters Facility. Design objectives and operation specific information was utilized to attain a better understanding of the design criterion use of this facility. Throughout this report calculations and tables from past technical reports have been included in order to observe how the various systems affect one another as well as the system as a whole.

This system design was a response to the owner's RFP, and addresses all of the owner's wants and needs. The majority of the facility is office space, and the mechanical design was based upon there. The facility also has diverse spaces such as labs, wellness center, cafeteria which present unique design criterion. Design conditions, equipment schedules, schematics and detailed descriptions have been provided to help understand the systems in the DISA HQ.

The DISA HQ mechanical system first cost was $50,000,000.00, or $46.73/SF. Actual utility/energy consumptions are not yet known due to the fact that this project is still under construction. Therefore, all energy calculations were found by utilizing Trane TRACE energy modeling software.

A critique of the system has been provided which evaluates the system to be sufficient and logical based on the design objectives. There have been some discrepancies found in the heating, cooling, & ventilation loads, however these seem to be a result of the precision of the Trace model.

Introduction

The DISA HQ facility is comprised of six connected buildings: Command, Operations, Acquisitions, Lab, Warehouse and Central Plant. They are interconnected by a Concourse at Level 2 (primarily service circulation and utilities) and Level 3 (primary internal pedestrian circulation).

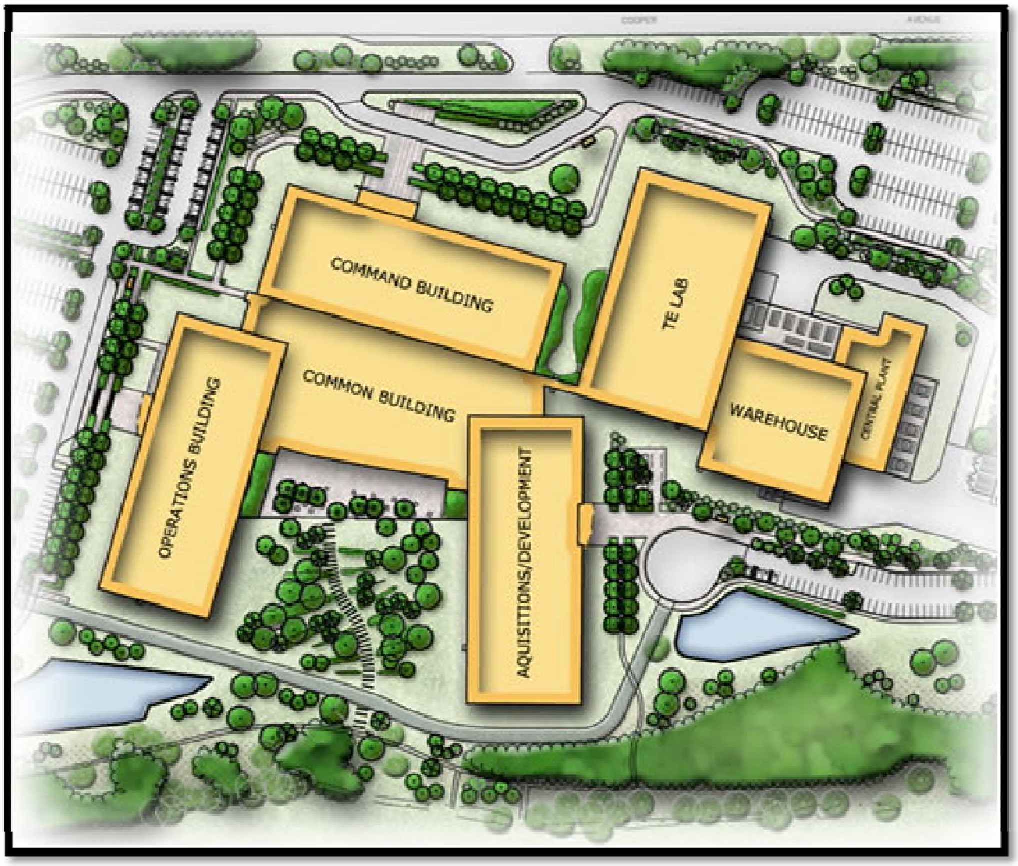


Figure 1- Campus Site Plan

The project is a complex with approximately 70% office space, 7% Lab Space, 10% Common (Multiuse) area, and 13% Special Use Spaces, based on program floor area. The Central Utility Plant (CUP) is shown attached to the Warehouse in Figure 1 above. This building contains the Boilers and Chillers which distribute Campus chilled and heating water to the entire complex. The cooling loads are extremely high for this complex, while the heating loads are minor.

The HVAC system selection for the DISA HQ was driven by the following criteria:

- **The need for flexibility to accommodate future change**
- **The project goal of 30% energy conservation compared to ASHRAE Standard 90.1 – 2004.**
- **Employee Comfort**
- **Best life cycle cost**

The design indoor air conditions were specified by the RFP, while the outdoor air conditions were obtained from the ASHRAE Handbook of Fundamentals 2005 and are noted below in Figure 2.

Outside Temperature and Humidity Conditions (ASHRAE Fundamentals 2005)	
Outside Design Conditions	Summer
Dry bulb and coincident wet bulb - Envelope	93.6°F DB/75.0°F WB
Wet bulb and Coincident dry bulb – 100% OA Coils	77.2°F DB/82.4°F WB
Wet bulb for evaporative heat rejection	78.1°F WB
Outside Design Conditions	Winter
Dry bulb and Humidity Ratio (HR)	12.3°F at 4.6 gr/lb

Figure 2 - Design Outdoor Conditions- Baltimore, MD.

Indoor Design Conditions	
Space	Summer T°F / % RH/ Winter Temp°F
Open Offices	75/50/72
Private Offices	75/50/72
Server Rooms	65-68/MAX 60/65-68
Lab Areas	65-68/MAX 60/65-68
Ftiness	68/MAX 60/68
Dining	75/MAX 60/72

Figure 3 - Design Indoor Conditions

BUILDING	COOLING LOAD (TONS)	SF/Ton	HEATING LOAD (MBH)	BTU/SF
COMMAND	1164.5	199	2824	12.2
ACQUISITIONS	621.1	431	3027	11.3
OPERATIONS	507.6	421	2505	11.7
COMMON	466.8	234	3653	33.4
LAB	1362.8	67	1061	11.6
WAREHOUSE	32.2	457	756	51.4
TOTAL	4155	301.5	13826	21.9

Figure 4- Design Heating & Cooling Loads

Detailed Systems Description

Central Utility Plant

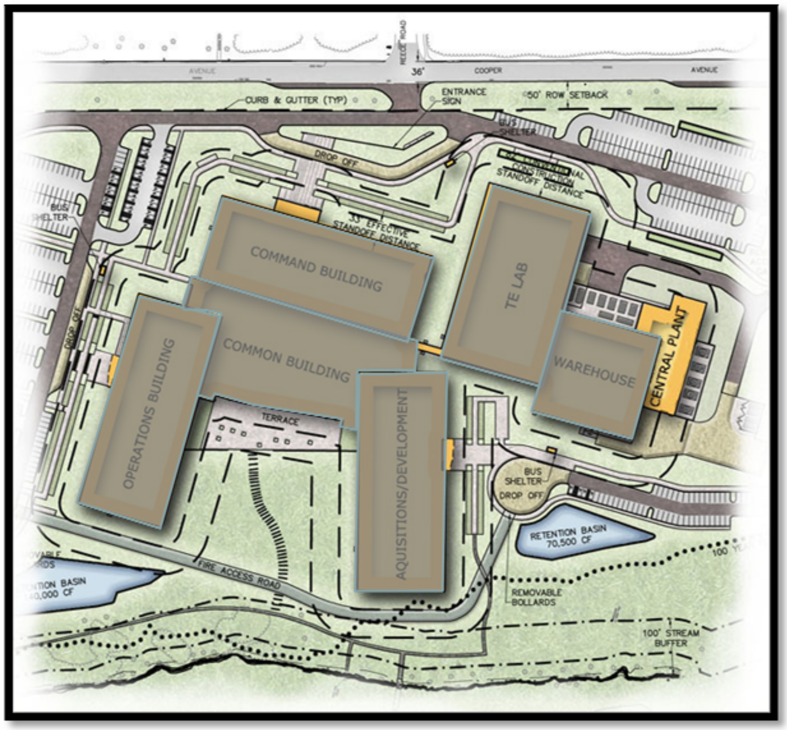


Figure 5-Central Utility Plant

A Central Utility Plant is attached to the Warehouse building and contains the DISA HQ's Central Heating and Cooling Plants. The Central Cooling Plant consists of four (4) Centrifugal chillers **each with a capacity of 950 tons** piped in two (2) pairs of series/counter flow configuration for highest possible chiller efficiency. The chillers will deliver CHW at 42°F, with return water at 60°F, and the plant will meet the entire cooling loads of the facility. Space in the plant will be allocated for a future chiller, pumps, and cooling tower as expansion is expected.

Four (4) Cooling towers will be located in a cooling tower yard adjacent to the plan and will be equipped with fan VDS's and electric sump heaters. The towers are piped to a suction header from which four (4) centrifugal vertical split case CW pumps will be piped to a distribution header, then finally to the individual chiller condensers. Non-chemical water treatment will be provided for the CW system.

Four (4) CHW pumps will serve the entire facility, while a fifth (5) pump will be on standby. Each CHW pump has a VSD. **A system of insulated supply and return CHW piping will be provided to serve the entire facility.**

The route of the piping will be through the Warehouse into the Service Corridor, where it will run overhead, with isolation valve branches to each major building along the route. To serve the roof mounted AHU's in the office buildings CHW supply and return risers will be located in the return air shafts to the units. Telecommunications closet CRAC units will be served by separate risers adjacent to the CRAC units. The CRAC units and risers will be in separate enclosures with access from the corridor.

To handle the Mission Critical spaces, two (2) chillers, with two (2) cooling towers, CW & CHW pumps will be available on emergency power.

ID TAG	MANUFACTURER/ MODEL	TYPE	NOMINAL CAPACITY (Tons)	kW / TON AT DESIGN (ARI)	REFRIG TYPE	NPLV	EVAPORATOR FLOW (gpm)	EVAPORATOR EWT (°F)	EVAPORATOR LWT (°F)	EVAPORATOR dPW (ft wc)	CONDENSER FLOW (gpm)	CONDENSER EWT (°F)	CONDENSER LWT (°F)	CONDENSER dPW (ft wc)
CHLR-1	CARRIER 19XRV	WATER COOLED HERMETIC CENTRIFUGAL	975	0.521	R-134A	0.297	2,535	59.9	50.7	16.2	3,500	90.8	98.5	20.2
CHLR-2	CARRIER 19XRV	WATER COOLED HERMETIC CENTRIFUGAL	925	0.551	R-134A	0.353	2,535	50.7	42.0	16.6	3,500	83.5	90.8	20.4
CHLR-3	CARRIER 19XRV	WATER COOLED HERMETIC CENTRIFUGAL	975	0.521	R-134A	0.297	2,535	59.9	50.7	16.2	3,500	90.8	98.5	20.2
CHLR-4	CARRIER 19XRV	WATER COOLED HERMETIC CENTRIFUGAL	925	0.551	R-134A	0.353	2,535	50.7	42.0	16.6	3,500	83.5	90.8	20.4

Figure 6- Chiller Schedule

ID TAG	MANUFACTURER/ SERIES	MODEL	SERVICE	FLOW (gpm)	HEAD (ft wc)	NPSH REQ'D (ft wc)	IMPELLER DIAMETER (in)	PUMP EFFICIENCY (%)	RPM	PUMP MOTOR SHAFT POWER (Bhp)	PUMP MOTOR MOTOR SIZE (Hp)	PUMP MOTOR Volt/Hz/Ph
CHWP-1	ARMSTRONG 4030	8x6x15	CHILLED WATER	1,265	175	6.9	13.24	80.01	1,780	69.9	100	460/60/3
CHWP-2	ARMSTRONG 4030	8x6x15	CHILLED WATER	1,265	175	6.9	13.24	80.01	1,780	69.9	100	460/60/3
CHWP-3	ARMSTRONG 4030	8x6x15	CHILLED WATER	1,265	175	6.9	13.24	80.01	1,780	69.9	100	460/60/3
CHWP-4	ARMSTRONG 4030	8x6x15	CHILLED WATER	1,265	175	6.9	13.24	80.01	1,780	69.9	100	460/60/3
CHWP-5	ARMSTRONG 4030	8x6x15	CHILLED WATER	1,265	175	6.9	13.24	80.01	1,780	69.9	100	460/60/3
CWP-1	ARMSTRONG 4030	8x6x11.5	CONDENSER WATER	1,750	90	8.1	10.80	87.15	1,770	45.6	60	460/60/3
CWP-2	ARMSTRONG 4030	8x6x11.5	CONDENSER WATER	1,750	90	8.1	10.80	87.15	1,770	45.6	60	460/60/3
CWP-3	ARMSTRONG 4030	8x6x11.5	CONDENSER WATER	1,750	90	8.1	10.80	87.15	1,770	45.6	60	460/60/3
CWP-4	ARMSTRONG 4030	8x6x11.5	CONDENSER WATER	1,750	90	8.1	10.80	87.15	1,770	45.6	60	460/60/3
CWP-5	ARMSTRONG 4030	8x6x11.5	CONDENSER WATER	1,750	90	8.1	10.80	87.15	1,770	45.6	60	460/60/3

Figure 7- Chilled & Condenser Water Pumps Schedule

ID TAG	MANUFACTURER/ MODEL	TYPE	DESIGN TOWER CAPACITY (MBH)	DESIGN AMBIENT WB (°F)	DESIGN FLUID FLOW PER CELL (gpm)	EWT (°F) (DESIGN)	LWT (°F) (DESIGN)	dPW (ft wc)	AIRFLOW PER CELL (cfm)
CT-1	EVAPCO AT-114-0324	INDUCED DRAFT COUNTERFLOW	13,125	78.0	1,750	98.5	83.5	1.8	163,200
CT-2	EVAPCO AT-114-0324	INDUCED DRAFT COUNTERFLOW	13,125	78.0	1,750	98.5	83.5	1.8	163,200
CT-3	EVAPCO AT-114-0324	INDUCED DRAFT COUNTERFLOW	13,125	78.0	1,750	98.5	83.5	1.8	163,200
CT-4	EVAPCO AT-114-0324	INDUCED DRAFT COUNTERFLOW	13,125	78.0	1,750	98.5	83.5	1.8	163,200

Figure 8- Cooling Tower Schedule

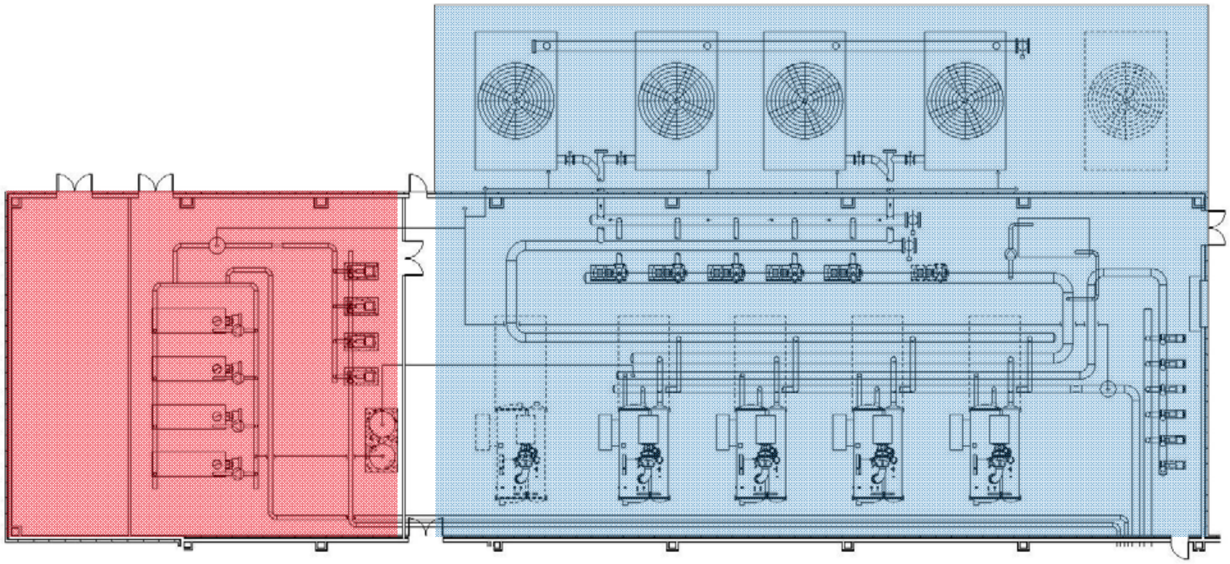
A Heating Plant will be provided adjacent to the Cooling Plant, in a separate enclosed room. The plant consists of four (4) gas fired HW boilers, three (3) of which will handle the entire facility's heating capacity with one (1) as standby. The plant will operate at a maximum HW supply temperature of 200°F and a return water temperature of 160°F with reset capability down to 180°F supply temperature during mild weather. Each boiler will be provided with a primary in-line circulating pump, piped individually to each boiler. Three (3) end suction secondary pumps will serve as the HW distribution for the entire facility. A system of insulated Supply and Return HW piping will run with the CHW piping, with isolation valves at branches to each major building.

ID TAG	MANUFACTURER/ SERIES	MODEL	CAPACITY		FLOW (gpm)	EWT (°F)	LWT (°F)
			INPUT (MBH)	OUTPUT (MBH)			
BLR-1	BRYAN RV SERIES	RV800-W	8,000	6,720	310	160	200
BLR-2	BRYAN RV SERIES	RV800-W	8,000	6,720	310	160	200
BLR-3	BRYAN RV SERIES	RV800-W	8,000	6,720	310	160	200
BLR-4	BRYAN RV SERIES	RV800-W	8,000	6,720	310	160	200

Figure 9 – Boiler Schedule

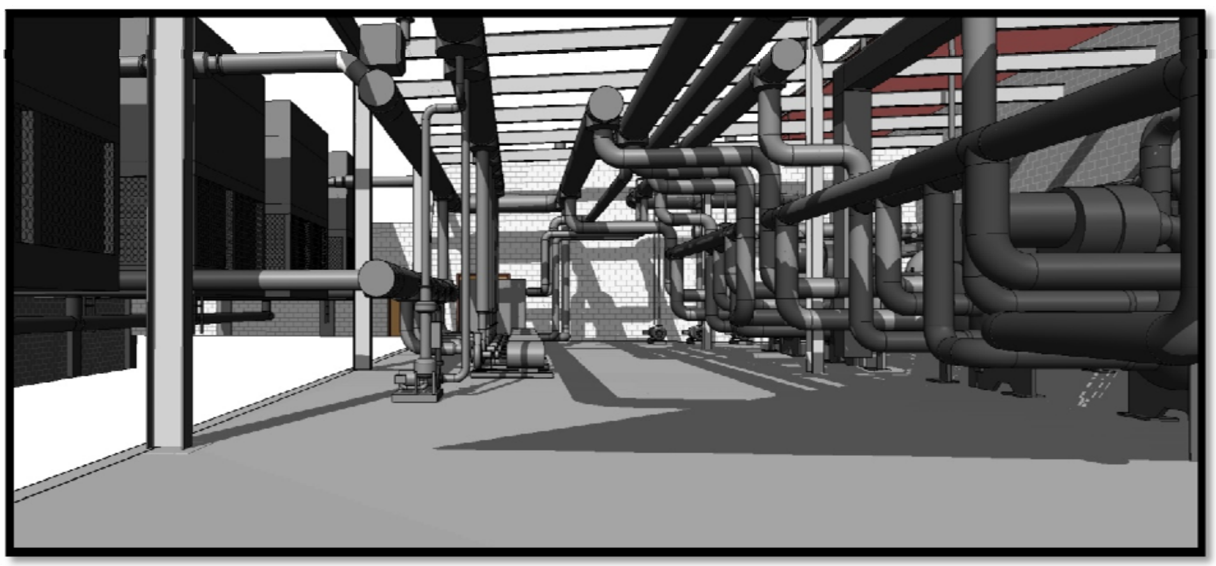
ID TAG	MANUFACTURER/ SERIES	MODEL	SERVICE	FLOW (gpm)	HEAD (ft wc)	NPSH REQ'D (ft wc)	IMPELLER DIAMETER (in)	PUMP EFFICIENCY (%)	RPM	PUMP MOTOR		
										SHAFT POWER (Bhp)	MOTOR SIZE (Hp)	Volt/Hz/Ph
PHWP-1	ARMSTRONG 4030	6x4x8	PRIMARY HEATING HOT WATER	310	15	3.8	6.83	81.59	1,150	1.4	2	460/60/3
PHWP-2	ARMSTRONG 4030	6x4x8	PRIMARY HEATING HOT WATER	310	15	3.8	6.83	81.59	1,150	1.4	2	460/60/3
PHWP-3	ARMSTRONG 4030	6x4x8	PRIMARY HEATING HOT WATER	310	15	3.8	6.83	81.59	1,150	1.4	2	460/60/3
PHWP-4	ARMSTRONG 4030	6x4x8	PRIMARY HEATING HOT WATER	310	15	3.8	6.83	81.59	1,150	1.4	2	460/60/3
SHWP-1	ARMSTRONG 4030	3x2.5x6	SECONDARY HEATING HOT WATER	310	115	10.3	6.09	75.70	3,500	11.9	15	460/60/3
SHWP-2	ARMSTRONG 4030	3x2.5x6	SECONDARY HEATING HOT WATER	310	115	10.3	6.09	75.70	3,500	11.9	15	460/60/3
SHWP-3	ARMSTRONG 4030	3x2.5x6	SECONDARY HEATING HOT WATER	310	115	10.3	6.09	75.70	3,500	11.9	15	460/60/3
SHWP-4	ARMSTRONG 4030	3x2.5x6	SECONDARY HEATING HOT WATER	310	115	10.3	6.09	75.70	3,500	11.9	15	460/60/3

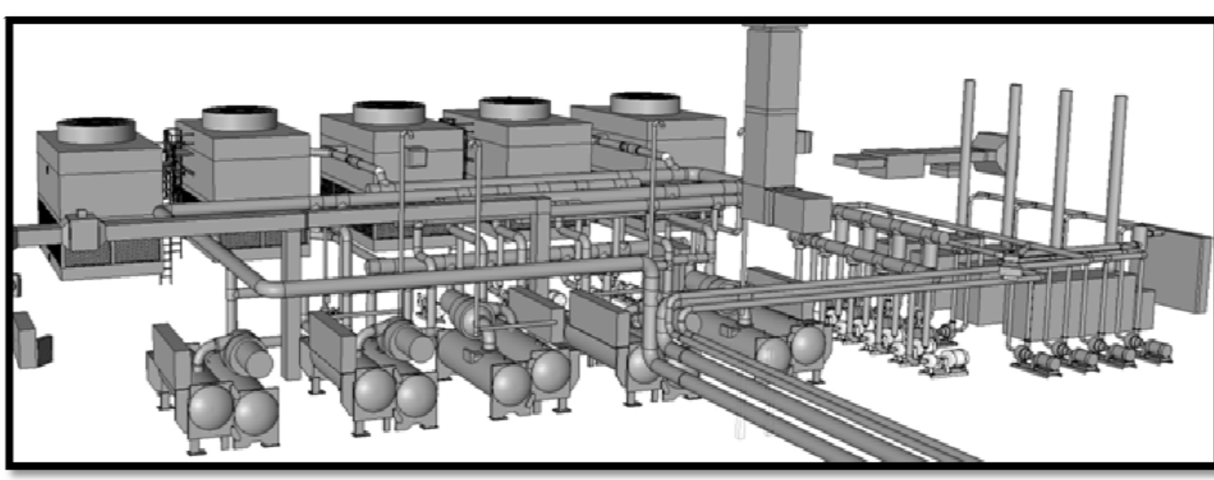
Figure 10- Heating HW Primary & Secondary Pump Schedule



Central Heating Plant (Shown in Red) & Central Cooling Plant (Shown in Blue)

Figure 11 Central Utility Plant





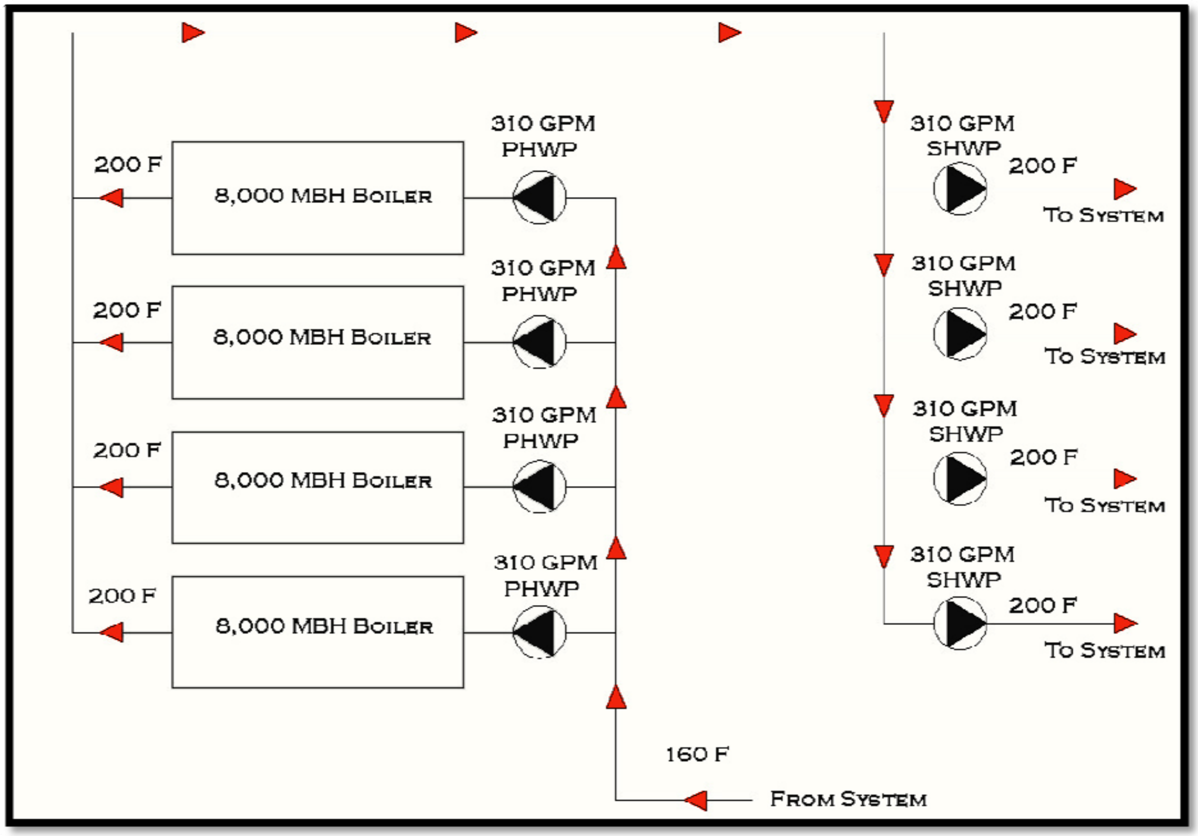
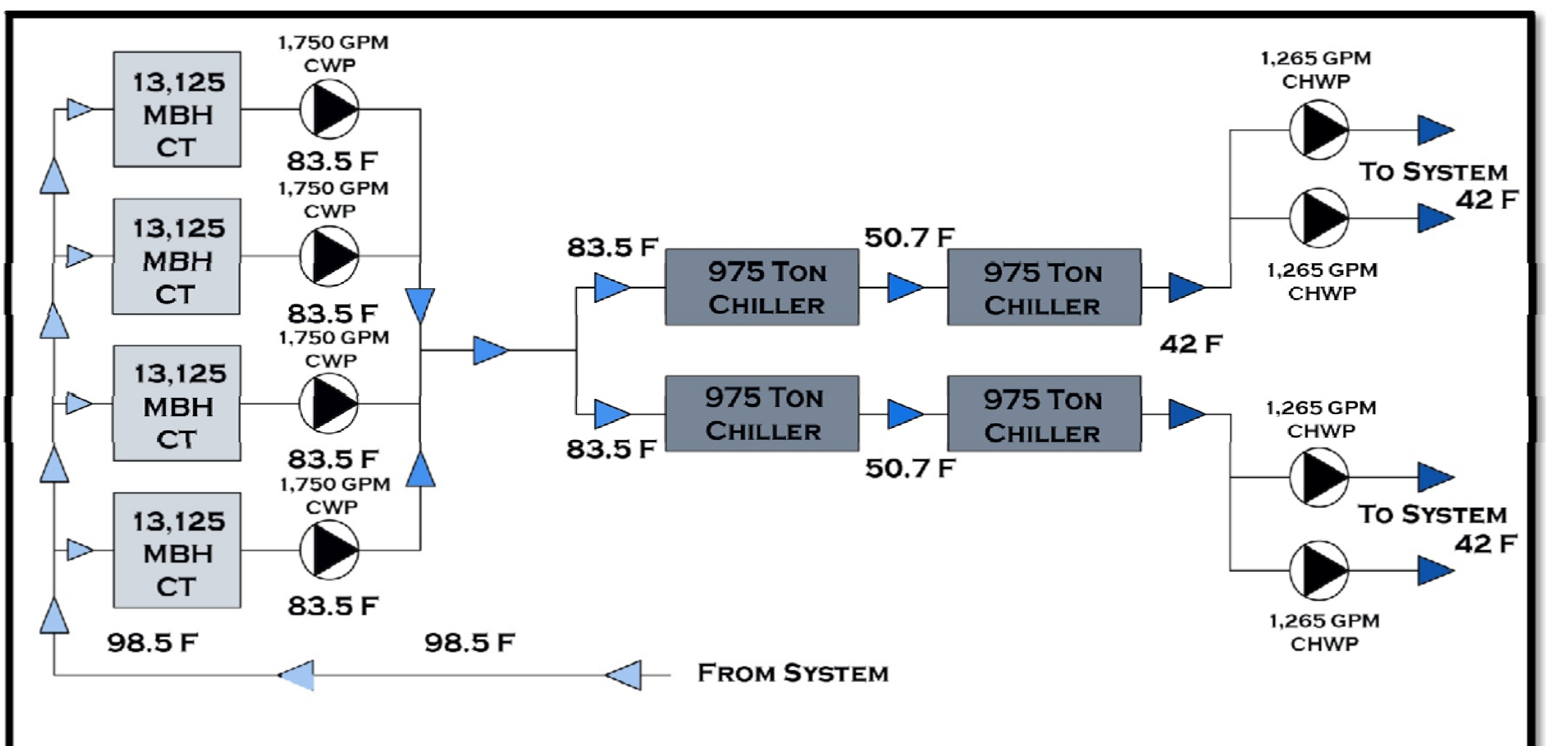


Figure 12- Heating Plant Schematic

Figure 13- Cooling Plant Schematic



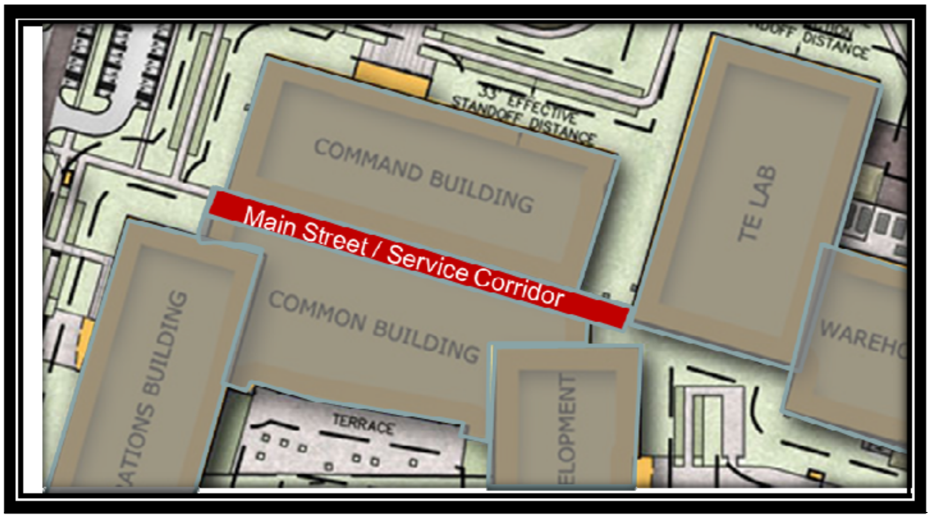


Figure 14 Main Street/Service Corridor:

Main Street is a two story connecting circulation for all buildings and occurs at Level 1. This area doubles as the main circulation spine on the top level for all occupants, and as a service corridor on the level below. All CHW/HW distribution from the CUP in the Warehouse runs through this corridor and branches into the other buildings.

DISA HQ Energy Sources

Water Supply- The site is serviced by a 10" PVC connection.

Electrical Service- Provided by Baltimore Gas & Electric (BG &E). The peak and off peak rates and breakdown can be found in the attached appendix A.

Natural Gas Service is Provided by BG & E. The Customer Charges include a $35.00/mo flat rate plus $0.1975/therm (1st 10,000 therms) & $0.0948/therm for remaining

OFFICE BUILDINGS (COMMAND, ACQUISITIONS, OPERATIONS)

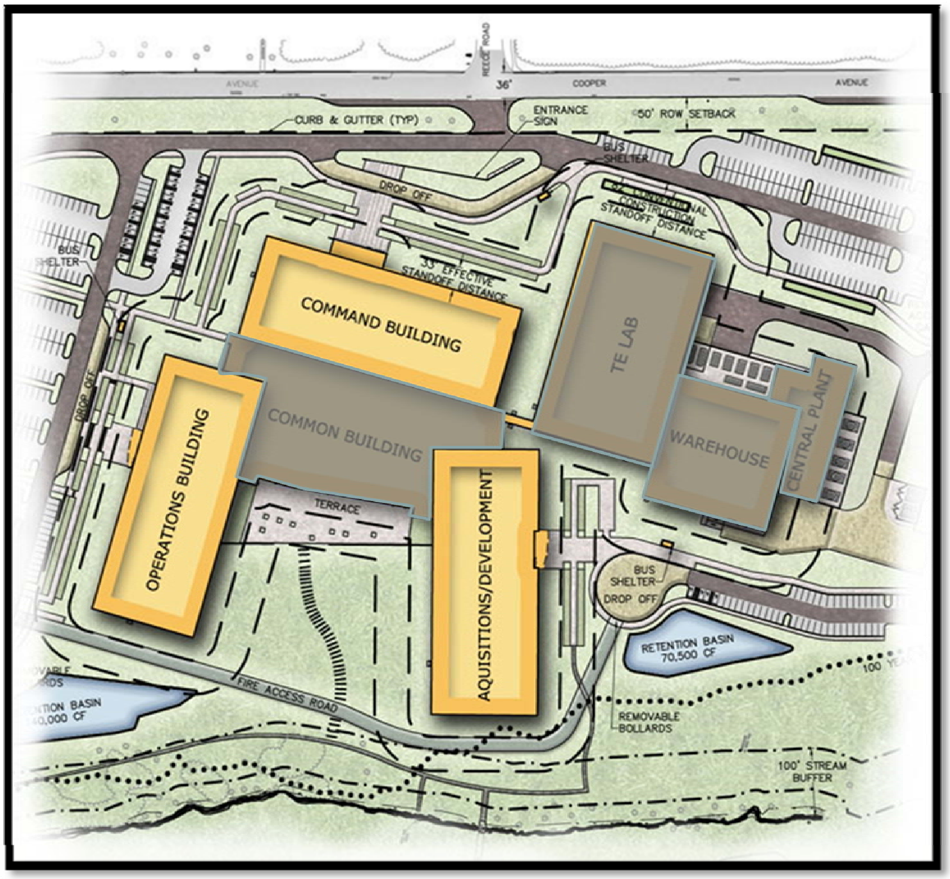


Figure 15 – General Office Spaces

An Under Floor Air Distribution (UFAD) system will be provided for all typical office spaces via an 18" raised access floor. The UFAD system will pressurize the under floor plenum using supply air at a temperature between 62°F and 68°F. This UFAD system was implemented due to an increased energy efficiency compared to a conventional overhead system, reduced maintenance costs, increased occupant comfort as well as improved IAQ & ventilation. The ability to save energy while giving each employee ultimate control of their comfort via swirl diffusers along with the potential for LEED points were the driving factors of this decision.

The perimeter was treated as a "skin" system or a narrow exterior zone within which handles only the exterior envelope heat gains and losses. Perimeter Under Floor Terminal Units (UFT's) were installed, with a system of insulated flexible supply air duct connected to linear bar type floor diffusers located under the windows. HW coils in each UFT will provide perimeter heating.

By controlling the perimeter as a skin system, a large cooling only interior zone was created for the rest of the air handling zone. Each office floor is divided into three (3) air handling zones served by risers. All UFT HW coils will be served by insulated copper HW piping within the raised floor. A typical office layout is shown below in Figure II.2-2.

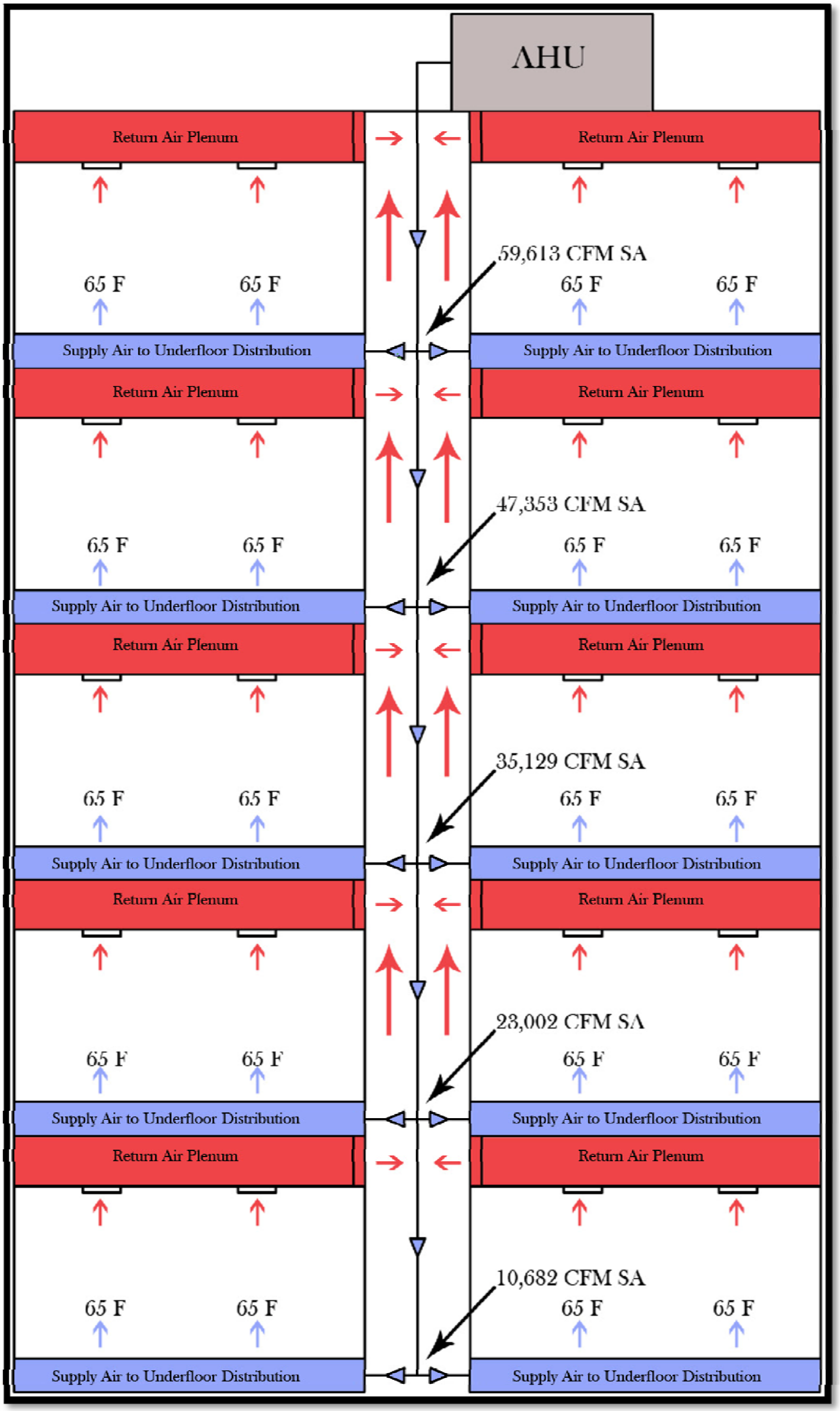


Figure 16: UFAD Acquisitions Building Core AHU Riser Diagram

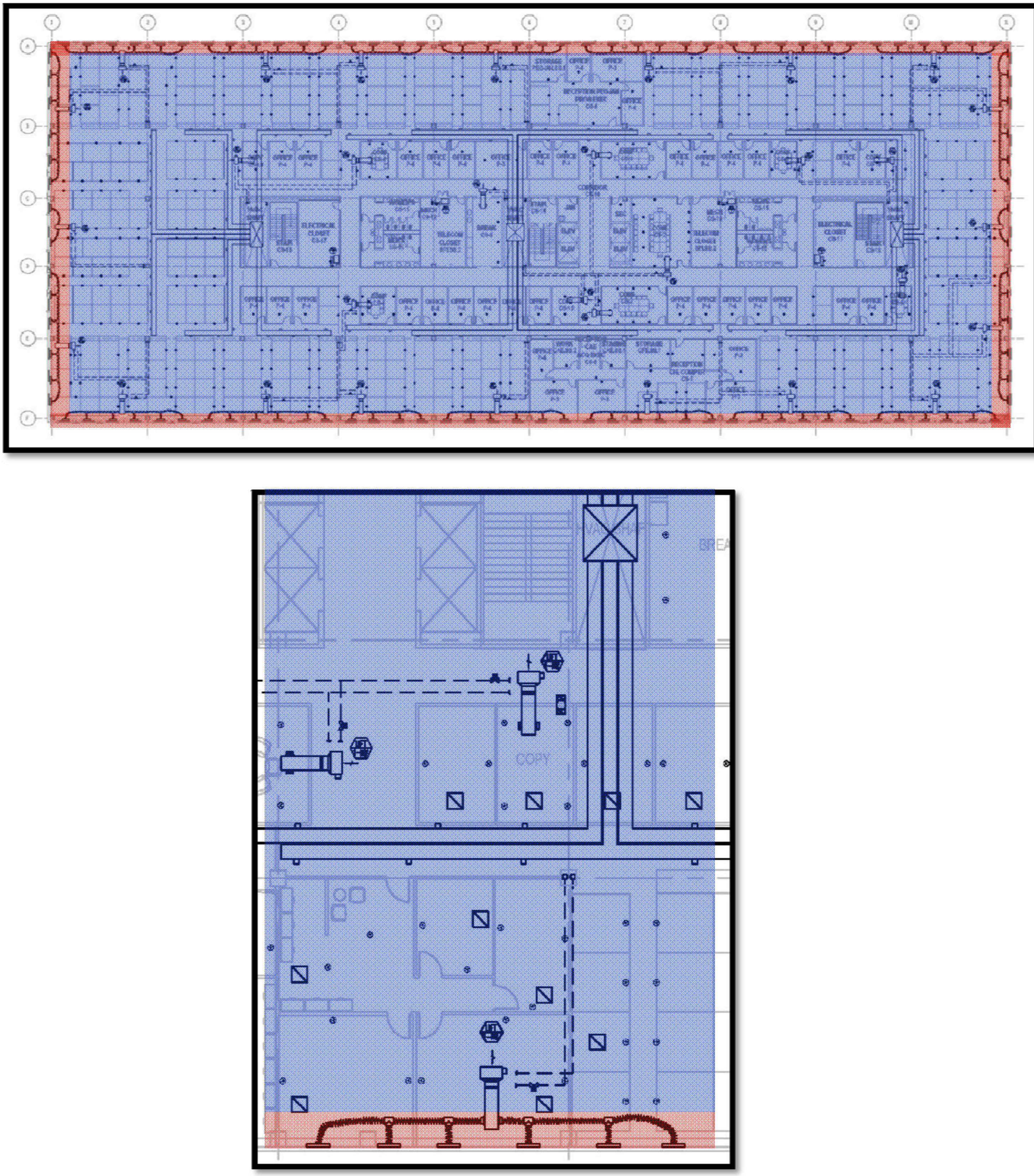


Figure 17- Typical Office UFAD Layout: Perimeter Skin (Red), Core (Blue)

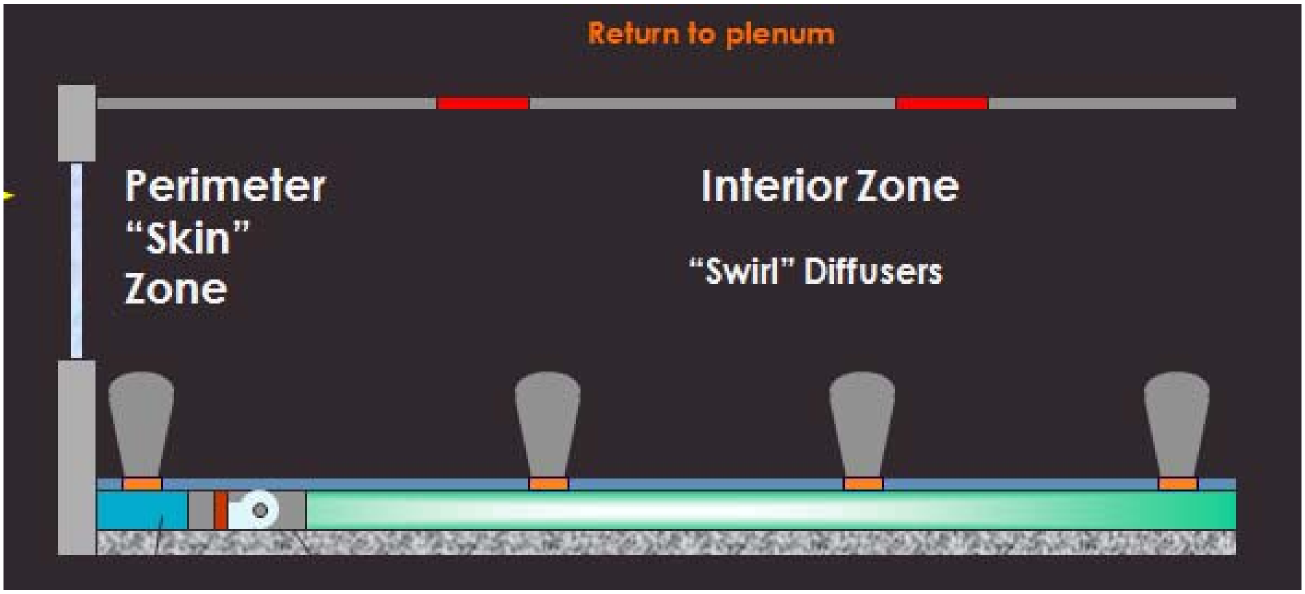


Figure 18-UFAD Detail

For each building there will be a total of three (3) roof level custom AHU's that will connect to ducted supply air risers in the central core shafts. The supply fan in each AHU will be installed with a VSD, controlled from downstream duct pressure. Return air enters the ceiling plenum and continues to the riser shaft which conveys the air to the roof level AHU's

The AHU's were placed on the roof to ensure that the Outside Air Intakes were well above the minimum 10' above grade for increased Anti-Terrorism/Force Protection. Also, the rooftop mechanical space was not deducted from the building square footage resulting in a maximum program area for occupants.

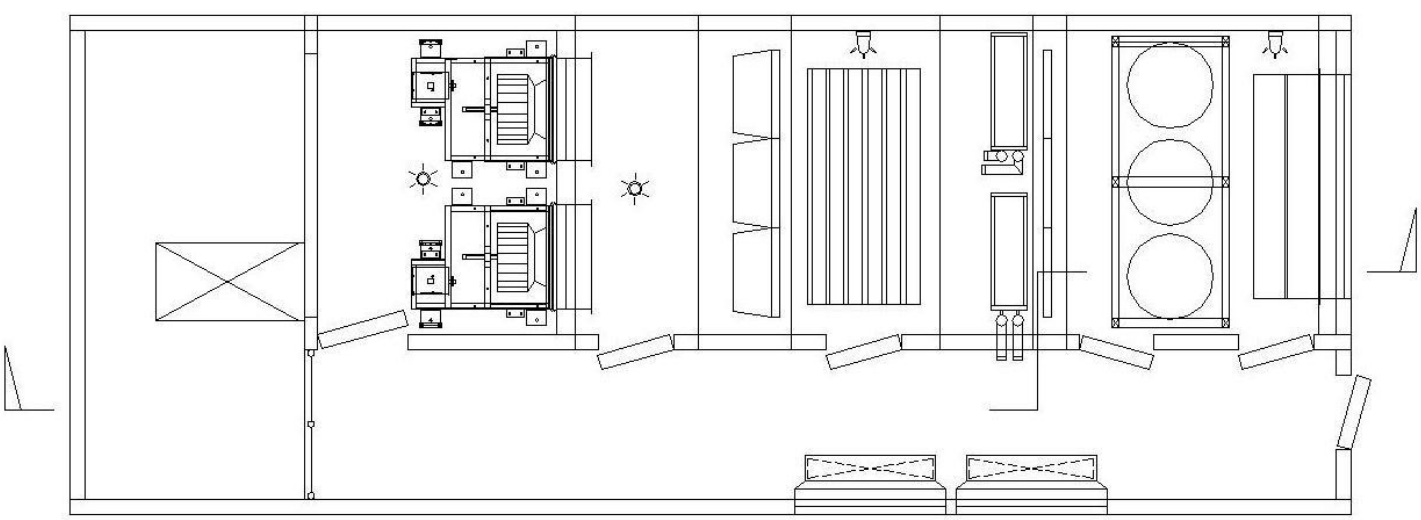


Figure 19 – Typical Custom AHU Plan View

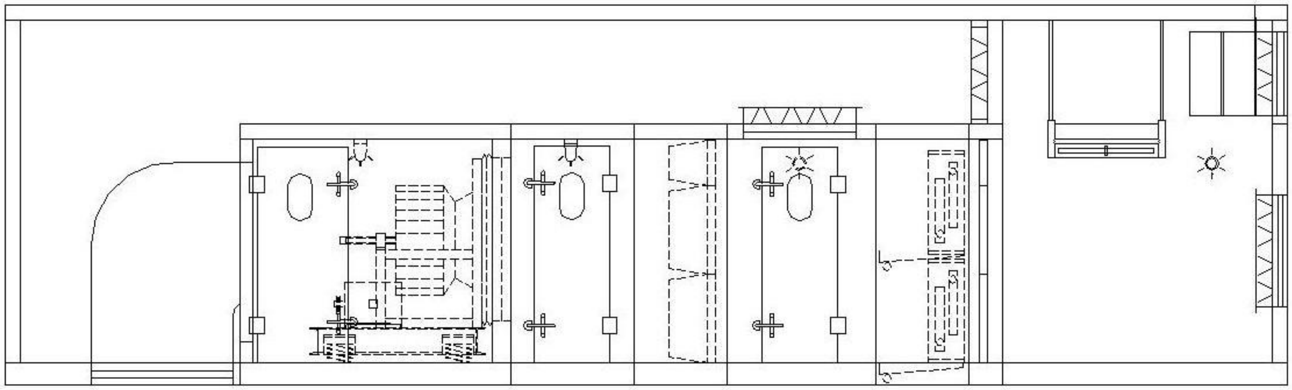


Figure 20- Typical Custom AHU Elevation

ID TAG	MANUFACTURER/ MODEL	LOCATION	SERVICE	SUPPLY AIR FAN				
				# FANS	FAN AIRFLOW (cfm)	OUTSIDE AIR (cfm)	SA TEMP (°F)	MOTOR SIZE (hp)
O-AHU-1	BUFFALO	OPERATIONS ROOF	OFFICE UFAD LEFT CORE	1	38,000	7,030	62	40
O-AHU-2	BUFFALO	OPERATIONS ROOF	OFFICE UFAD CENTER CORE	2	25,250	9,345	62	2 @ 20
O-AHU-3	BUFFALO	OPERATIONS ROOF	OFFICE UFAD RIGHT CORE	2	22,500	8,325	62	2 @ 20
A-AHU-1	BUFFALO	ACQUISITIONS ROOF	OFFICE UFAD LEFT CORE	2	27,250	10,085	62	2 @ 25
A-AHU-2	BUFFALO	ACQUISITIONS ROOF	OFFICE UFAD CENTER CORE	2	31,000	11,470	62	2 @ 25
A-AHU-3	BUFFALO	ACQUISITIONS ROOF	OFFICE UFAD RIGHT CORE	2	24,250	8,975	62	2 @ 20

Figure 21- Custom AHU Schedule

UFAD System Operation:

The Central Utility Plant produces Heating Hot & Chilled Water which is piped through the warehouse and into the Main Service Corridor. This piping branches off at the Operations, Command, and Acquisitions Buildings. Upon entering the building, the piping is routed to the core shafts.

The Heating Hot Water piping risers branch off at each floor of the Office buildings and are routed underneath the raised access flooring. This piping then feeds the heating coils located in the perimeter Under Floor Terminal Units (UFT's).

The Chilled Water piping risers extend through the shaft to feed the cooling coils of the rooftop AHU's. The air is then cooled to 62°F and enters the supply duct. The supply ductwork extends down the shaft and branches off at each floor. At each floor, the supply air enters and pressurizes the under floor plenum. Each occupant has an adjustable swirl diffuser in their cubicle or office in which they can control how much air is being supplied to their area.

The core of the office buildings receive only cooling due to the high loads created by the equipment, lighting, and high occupancy of the office space. As the air in the plenum reaches the perimeter, a fan coil unit (Under Floor Terminal) pulls in the air and provides reheat if necessary. This air is then supplied to the space via linear slot diffusers located on the floor. This is known as an exterior perimeter "skin" system and is utilized to combat exterior heat gains/losses depending on the season.

TE LAB

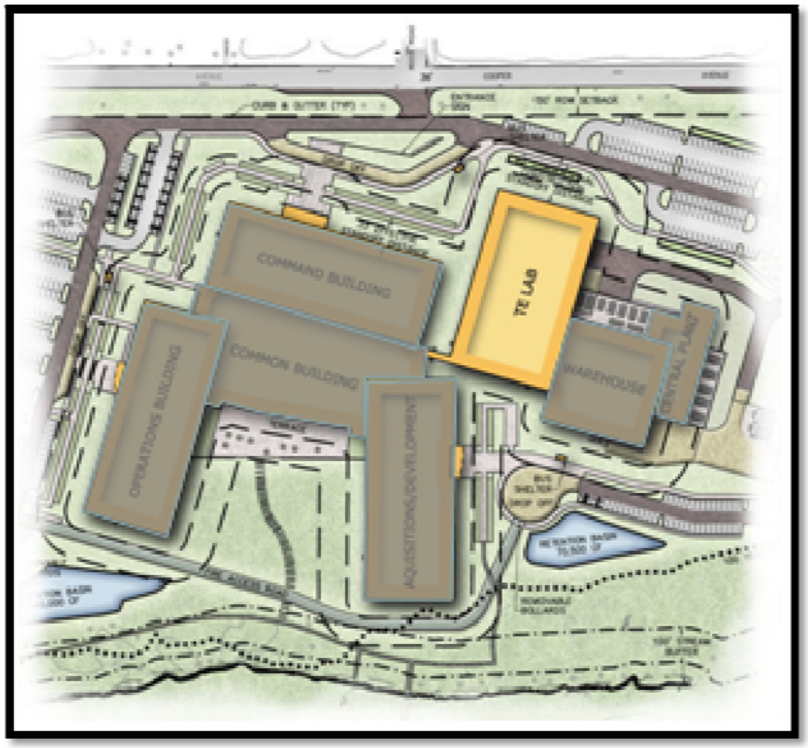


Figure 22- TE LAB

The TE Lab HVAC load requirements are 30% of the total cooling load for the entire facility, so energy efficiency for these systems is extremely important. Vertical air flow, Chilled Water AHU's designed specifically for data centers are coupled with direct injection outdoor air systems to provide both ventilation and humidity control to satisfy the unique demands of a data center with high personnel occupancy. These units will be located in two (2) secure equipment rooms.

This system requires less maintenance, offers great flexibility for lab configurations, and provides greater energy efficiency than provided by traditional Computer Room Air Conditioning (CRAC) units.

Each floor has nine (9) AHU's plus one (1) standby for a total of 20. The supply air is supplied to the TE Lab via perforated floor tiles with manual balancing dampers. Return air will be extracted from the space via RA grilles and into the ceiling plenum until finally reaching the CHW AHU's in the equipment room.

Two (2) 100% OA constant volume AHU's, located in the same equipment rooms as the vertical AHU's distribute air to the TE Lab space and to the individual "hotel" rooms via Constant Air Volume (CAV) terminal units.

The purpose of the CAV terminals is to allow OA quantities to be re-directed to areas of higher occupancy in the future by digital entry at the BAS control console. A system of under floor CHW supply and return piping (sized for future loads of 70 W/SF) was installed as well.

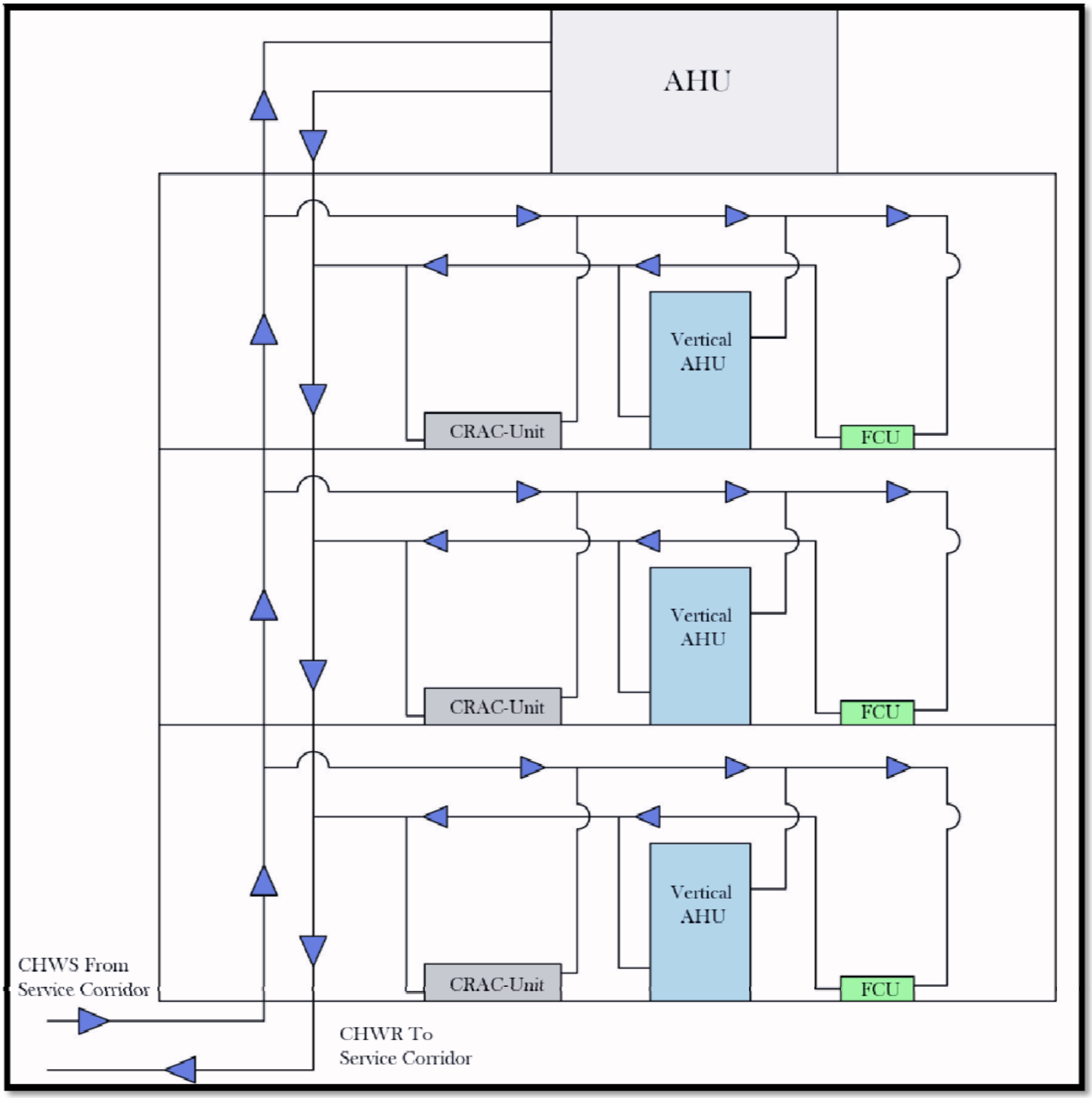


Figure 23- Lab Chilled Water Schematic

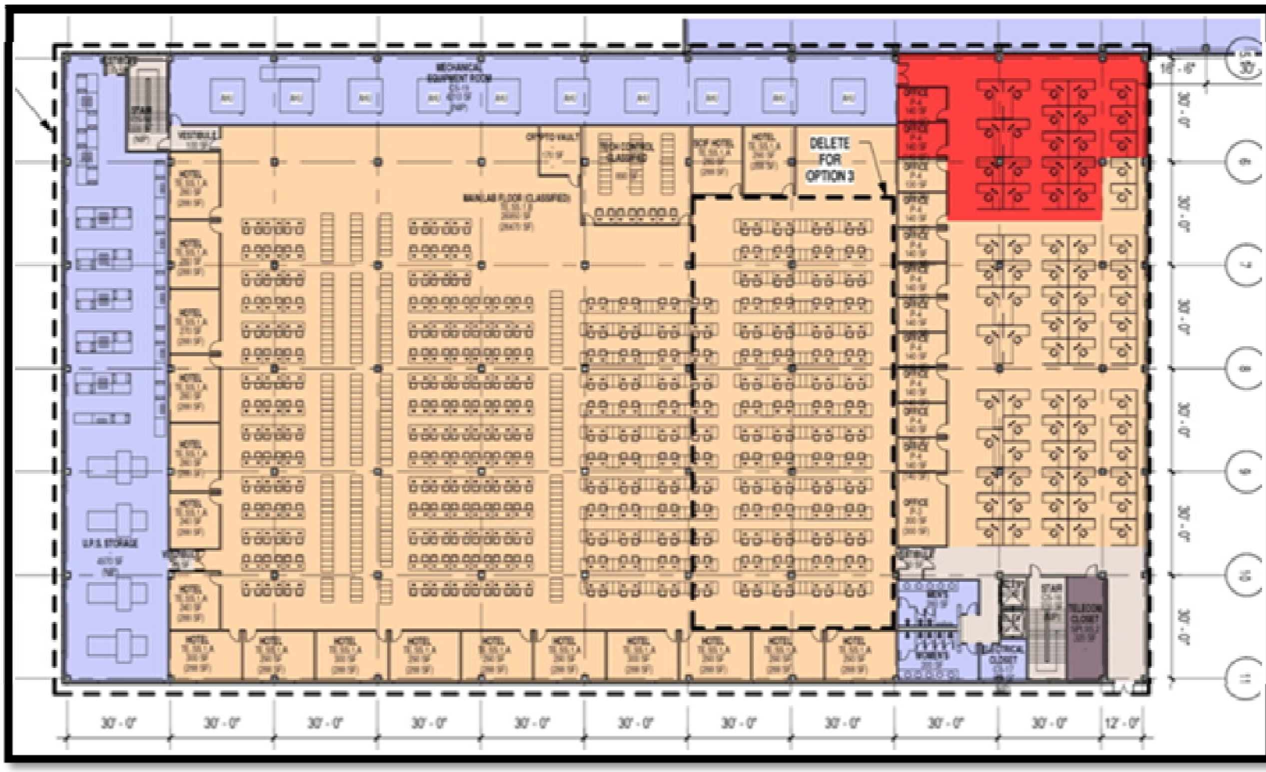


Figure 24- Lab Floor Plan

ID TAG	MANUFACTURER/ MODEL	LOCATION	SERVICE	SUPPLY AIR FAN # FANS	UNIT AIRFLOW (cfm)	OUTSIDE AIR (cfm)	SA TEMP (°F)	MOTOR BRAKE HP (bhp)	MOTOR SIZE (hp)	MOTOR Volt/Ph/Hz	COOLING COIL TOTAL CAPACITY (MBH)	COOLING COIL SENSIBLE CAPACITY (MBH)
L-OHU-1	CARRIER 39 M	LAB	DOAS SYSTEM	1	10,500	10,500	52	11.2	15	460/60/3	868	511
L-AHU-(1-10)	RACAN	LAB MECH. RM.	LAB MLFS & HOTELS	1	34,000	-	65	15.7	20	460/60/3	805	794
L-AHU-(11-20)	RACAN	LAB MECH. RM.	LAB MLFS & HOTELS	1	32,000	-	65	14.3	20	460/60/3	768	757
L-AHU-21	CARRIER 39 M	LAB ROOF	LAB ADMIN	1	7,900	2,150	55	8.7	10	460/60/3	356	257

Figure 25- LAB AHU Schedule

Common Building

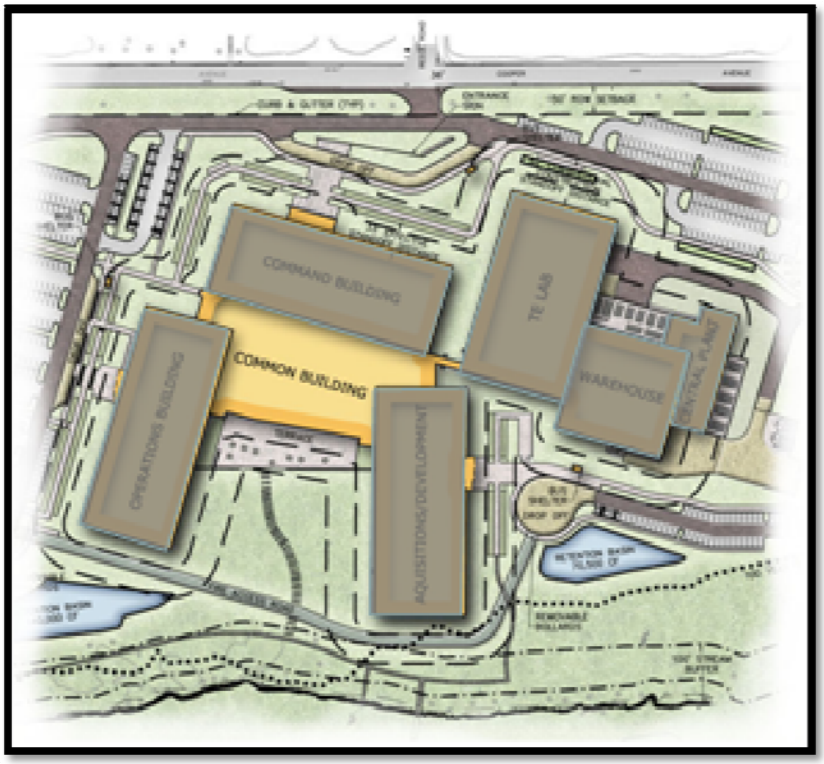


Figure 26- Common Building

The Common Building upper level will be serviced by UFAD via RAF. The lower level will be serviced by overhead VAV systems to accommodate dining, kitchen, fitness and locker room functions.

The Exercise Room will be provided with a separate overhead VAV system that operates in conjunction with the Locker Rooms. A separate roof mounted AHU will serve this area. The system will be similar to that described for the Dining Area. Locker Rooms will be ventilated by roof mounted exhaust fans. Transfer air from the Exercise Room will provide make-up air.

Lost Useable Space:

The RFP for this project carefully laid out exactly what square footage would be allowed for the mechanical system. The shafts were efficiently laid out to carry the supply duct, CHWS/R, HWS/R, and also act as the return plenum. The UFAD system in the office area uses the RAF to house the mechanical system which did not lead to lost space. The AHU's are located on the roof, and the boilers/chillers are located in the warehouse.

Mechanical System First Cost:

The mechanical system first cost for the DISA HQ was $50M. This complex is 1, 070, 000 GSF, therefore the mechanical system first cost per square foot was $46.73/SF

Actual Energy Use

This information is not available due to the fact that the DISA HQ is still under construction.

L.E.E.D Analysis

The DISA HQ is projected to receive a LEED Silver Certification. The LEED for New Construction v2.2 checklist has been filled out and can be found in Appendix A.

The building's mechanical systems design and construction helped the DISA HQ project receive the following points:

-<u>Energy & Atmosphere</u>

- **Optimize Energy Performance: 14% New Buildings- 2 points**
- **Enhanced Commissioning- 1 point**
- **Enhanced Refrigerant Management- 1 point**

-<u>Indoor Environmental Quality</u>

- **Outdoor Air Delivery Monitoring: 1 point**
- **Construction IAQ Management Plan: During Construction & Occupancy-2 points**
- **Controllability of Systems, Thermal Comfort: 1 point**
- **Thermal Comfort Design & Verification: 2 points**

The mechanical system design and construction received 10 points of the total 34 points expected; however the actual mechanical system did not have an incredible effect on the LEED rating. Two points were awarded for making sure the ductwork was protected during construction to manage IAQ. Two points were also awarded for enhanced commissioning, and refrigerant management which is more of a reflection of building operation & management rather than mechanical design. A total of three points were also awarded for thermal comfort & controllability, which are a direct result of the UFAD system used in the office buildings.

CRITIQUE

Overall, this design was an excellent response to the RFP. The engineer was able to meet all recommendations, provide a system that is reasonable, and earn LEED credits for their design. I believe that the engineer did an excellent job designing within the parameters and design conditions they were given.

The Central Utility Plant is well designed, and should run very efficiently. The concept of putting the centrifugal chillers in series, will increase efficiency and lead to a higher delta T for the facility's campus chilled water. Chemical-free water treatment is being utilized in the cooling tower and led to a LEED innovation credit. I also believe that the main street/service corridor was an excellent idea. On the top floor, a beautiful walkway connects each building, while on the bottom floor it serves as a service corridor to serve HW & CHW to each building.

The RFP called for a raised access floor in the office space due to the abundance of telecommunications which needed to be routed throughout the buildings. This provided an excellent opportunity to use a UFAD system. Although these systems are being toughly scrutinized in ASHRAE journals and within professional communities, I believe it was the correct design for this application. This allowed DISA to have the raised access flooring, without compromising floor-floor height, which was especially important at Ft. Meade which has a height restriction on buildings.

The UFAD system not only helped gain potential LEED credits, but it will also give each occupant control of their own comfort. This however could be a gift and a curse in my point of view, it could be nice for the occupants in their cubicles but it may cause problems over time. I feel when you ultimately give people control of the system such as these swirl diffusers that you could ultimately end up with air conditions different than predicted and modeled. Overall, the system would still work in these conditions, but the thermal comfort may not be as good as originally designed. Overall, I still believe that this was the correct response to the design criteria for the office spaces.

In the special use spaces, the design calls for traditional over head air distribution which I also believe is the correct response. The UFAD system works well in office spaces, but would not function well in some of the other areas needed in the DISA HQ.

The Central Utility Plant is currently oversized and has room for more expansion. In the future, the TE lab is supposed to expand causing a need for much more cooling capacity. The system has been piped to deliver CHW with a capacity of 70 W/SF in this area. It seems as if this may be a bit of overkill, as the loads will probably never reach this level. This is something I am going to look further into during the proposal stage.

This project is projected to be awarded LEED Silver after gaining 34 points on the LEED NC 2.2 checklist. I feel that this building is not extremely "green", even though it will receive this recognition. The energy savings are minimal, and there is no use of renewable energy. I think that either due to budget constraints, or the size of the complex that the DISA HQ is not as environmentally friendly as it could have been designed. I think LEED makes it easy to receive accreditation through finding points, rather than making sure the building actually saves energy. In the proposal stage, I hope to look at how I can make this project green

APPENDIX A

ID TAG	LOCATION	SERVICE	SUPPLY AIR FAN # FANS	FAN AIRFLOW (cfm)	UNIT AIRFLOW (cfm)	OUTSIDE AIR (cfm)	TECH 1 ESTIMATE OUTSIDE AIR (cfm)
C-AHU-1	COMMAND ROOF	UFAD LVL. 3-5 LEFT CORE	1	27,000	27,000	4,995	N/A
C-AHU-2	COMMAND ROOF	UFAD LVL. 3-5 CENTER CORE	1	32,500	32,500	6,015	3,252
C-AHU-3	COMMAND ROOF	UFAD LVL. 3-5 RIGHT CORE	1	27,500	27,500	5,090	N/A
C-AHU-4A, -4R	COMMAND ROOF	UFAD LVL. 6 LEFT CORE	1	13,750	13,750	2,545	N/A
C-AHU-5A, -5R	COMMAND ROOF	UFAD LVL. 6 CENTER CORE	1	13,750	13,750	2,545	N/A
C-AHU-6A, -6R	COMMAND ROOF	UFAD LVL. 6 RIGHT CORE	1	13,750	13,750	2,545	N/A
C-AHU-7, -8, -9	-	-	-	-	-	-	N/A
C-AHU-10	C-LVL 4 MECH. RM.	COMMAND LOBBY	1	4,000	4,000	4,000	N/A
C-AHU-11A, -11R	C-LVL 2 MECH. RM.	C-LVL 2 ELECT. RMS.	1	11,650	11,650	-	N/A
L-OHU-1	LAB	DOAS SYSTEM	1	10,500	10,500	10,500	4,285
L-AHU-(1-10)	LAB MECH. RM.	LAB MLFS & HOTELS	1	34,000	34,000	-	4,285
L-AHU-(11-20)	LAB MECH. RM.	LAB MLFS & HOTELS	1	32,000	32,000	-	N/A
L-AHU-21	LAB ROOF	LAB ADMIN	1	7,900	7,900	2,150	N/A
W-AHU-1	WAREHOUSE ROOF	MAIL ROOM	1	1,500	1,500	300	N/A
W-AHU-2	WAREHOUSE ROOF	MAINTENANCE	1	7,600	7,600	6,600	N/A
M-AHU-1	COMMON ROOF	WELLNESS	1	3,000	3,000	800	670
M-AHU-2	COMMON ROOF	FITNESS	1	8,000	8,000	3,000	N/A
M-AHU-3	COMMON ROOF	DINING	1	24,680	24,680	21,000	N/A
M-AHU-4	COMMON ROOF	TRAINING CENTER	1	8,500	8,500	2,175	N/A
M-AHU-5	COMMON ROOF	CONFERENCE CENTER	1	21,500	21,500	7,250	N/A
M-AHU-6	COMMON ROOF	TV STUDIO	1	5,500	5,500	500	N/A
M-AHU-7	COMMON ROOF	AV STUDIO	1	8,200	8,200	1,200	N/A
M-OHU-1	COMMON ROOF	DOAS SYSTEM	1	1,900	1,900	1,900	N/A
O-AHU-1	OPERATIONS ROOF	OFFICE UFAD LEFT CORE	1	38,000	38,000	7,030	N/A
O-AHU-2	OPERATIONS ROOF	OFFICE UFAD CENTER CORE	2	25,250	50,500	9,345	N/A
O-AHU-3	OPERATIONS ROOF	OFFICE UFAD RIGHT CORE	2	22,500	45,000	8,325	N/A
A-AHU-1	ACQUISITIONS ROOF	OFFICE UFAD LEFT CORE	2	27,250	54,500	10,085	N/A
A-AHU-2	ACQUISITIONS ROOF	OFFICE UFAD CENTER CORE	2	31,000	62,000	11,470	N/A
A-AHU-3	ACQUISITIONS ROOF	OFFICE UFAD RIGHT CORE	2	24,250	48,500	8,975	N/A

ASHRAE 62.1 Minimum Outside Air Requirements Assignment 1

The results for the minimum OA calculations can be seen below. All of the AHU's calculated were in compliance with Standard 62.1.2007. The Lab OA requirements are handled by L-OHU-1, a DOAS system.

AHU	LOCATION SERVED	LOCATION	CFM	V_{BZ}	V_{OZ}	E	DESIGN MIN. OA	CALC. MIN. OA	COMPLIANCE
C-AHU-2	UFAD LVL. 3-5- CENTER CORE	COMMAND CENTER ROOF	32,500	3,252	32,500	1	6015	3,252	YES
M-AHU-1	COMMON-WELLNESS CNTR.	COMMON BLDG. ROOF	3,000	670.3	3,000	1	800	670.3	YES
L-AHU-1	LAB	LAB MECH. ROOM	32,000	0	0	1	0	4,285	-
L-OHU-1	LAB	LAB ROOF	10,500	10,500	-	-	10,500	4,285	YES

HEATING LOAD SUMMARY				
Building	Total Load(MBH)	A/C Area (ft^2)	BTU/SF	Note
Operations	3012.0	201,606	14.9	Calculated
Command	2824.0	231,926	12.2	Design Doc.
Acquisitions	3027.0	267,468	11.3	Design Doc.
Common	3653.0	109,350	33.4	Design Doc.
Lab	1061.0	91,704	11.6	Design Doc.
Warehouse	756.0	14,705	51.4	Design Doc.
TOTAL	14,333			

Figure A- XX- Calculated Heating Load Summary: Assignment 2

COOLING LOAD SUMMARY				
Building	Total Load(Tons)	A/C Area (ft^2)	ft^2/ton	Note
Operations	342.4	201,606	590.7	Calculated
Command	1164.0	231,926	199	Design Doc.
Acquisitions	621.0	267,468	431	Design Doc.
Common	467.0	109,350	234	Design Doc.
Lab	1363.0	91,704	67	Design Doc.
Warehouse	32.0	14,705	457	Design Doc.
TOTAL	3989.4			

Figure A- XX- Calculated Cooling Load Summary: Assignment 2

DISA HQ ANNUAL ENERGY COST ESTIMATE				
Building	Area (ft^2)	$/SF	Note	
Operations	201,606	$ 2.88	$ 580,625.28	Calculated
Command	231,926	$ 2.88	$ 667,946.88	Design Doc.
Acquisitions	267,468	$ 2.88	$ 770,307.84	Design Doc.
Common	109,350	$ 2.88	$ 314,928.00	Design Doc.
Lab	91,704	$ 5.00	$ 458,520.00	Design Doc.
Warehouse	14,705	$ 1.50	$ 22,057.50	Design Doc.
TOTAL			**$ 2,814,385.50**	

Figure A- XX- Estimated Annual Energy Cost Estimate: Assignment 2