Dallas Love Field Energy Assessment

Prepared for:

City of Dallas

City of Dallas, Department of Aviation

Dallas Love Field

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06/2022

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Overview

An energy assessment for the Dallas Love Field (DAL) Terminal, Central Utility Plant (CUP), Administration Building, Airfield Maintenance Building, and Police Station was conducted February 7-9, 2022 in accordance with American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) energy audit protocols. The scope of the assessment included evaluation of major mechanical systems, lighting systems and water heating systems. This report presents an evaluation of energy use through review of the Energy Use Intensity (EUI) as well as natural gas and electricity utility data; observations on the status of facilities and equipment at the time of the assessment; details on identified opportunities for implementing energy conservation measures (ECMs) and estimate simple payback (i.e., cost savings), summarized in Appendix B; as well as recommendations for areas of further study.

Executive Summary

The energy assessment revealed that the facilities were, in general, comparable to other airport facilities in regards to their EUI. While overall electricity and natural gas consumption reduced significantly from 2015 to 2016, consumption increased steadily from 2016 through 2019 with electricity showing an increase regardless of passenger throughput, an indicator that efficiency has been reduced possibly due to findings in the CUP.

Within the CUP, the energy assessment team found that while most equipment was well-maintained and operating efficiently, opportunities existed within temperature control systems. The thermal storage tank system had been modified from its original design and potential overpumping was resulting in day-time chiller operation at an increased rate. Similarly overpumping may occur on the heating hot water system with a heat exchanger that is not in use. Water quality issues were causing additional issues with chillers and cooling towers resulting in increased cost of parts and maintenance. Addressing these issues will lead to energy reductions as well as overall system operational improvement.

The equipment serving the main Terminal was found to be less than 8 years old and relatively efficient, as it was replaced during an expansion and upgrade in 2014, and lighting systems are currently being retrofitted with light-emitting diode (LED) lights. The greatest opportunity exists primarily with building automation and lighting control as lights, escalators and other equipment remained on when unoccupied, and the daylight harvesting system was not fully functional. Using or expanding automation and control systems will reduce overall terminal consumption without significant capital expense.

Findings in the ancillary buildings, including the Airfield Maintenance Building, Administration Building and the Police Station were not significant, though among those buildings there is opportunity to incorporate existing controls to reduce run time for systems including heating, ventilation and air conditioning (HVAC) and lighting systems.

Utility Evaluation

Energy Use Intensity

EUI is a measure of energy consumption per square foot. The Commercial Building Energy Consumption Survey (CBECS) uses EUI to compare similar building types as a relative benchmark of utility consumption. CBECS is the basis of Energy Star Target Finder score generation and is a standardized way of benchmarking buildings. Although airports are not a building type that CBECs currently measures, other airport specific benchmarking data exists. Airport Cooperative Research Program (ACRP) Report 09-10 *Benchmarking and Profiling Airport Terminal Energy End Uses* was evaluated as a baseline to measure and benchmark airport utility usage.

Figure 1 displays an output of ACRP 09-10, showing a breakout of EUI for systems (including central plant systems) and floor area, which incorporates lighting and other energy used in the actual space and a combined measured value.

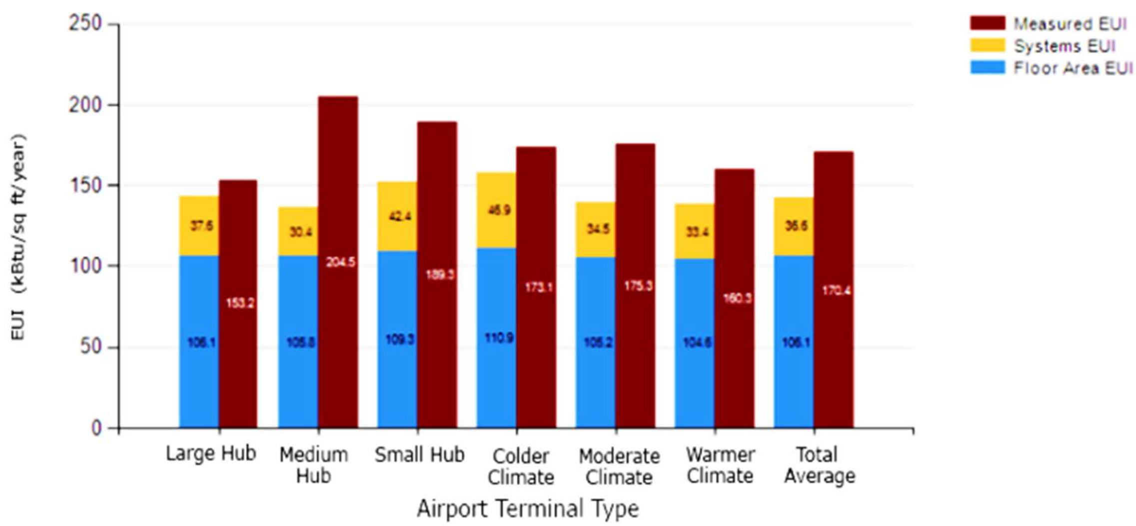

Figure 1. ACRP 09-10 Representative EUI

From tabulation of the provided utility information, a range of EUIs was calculated due to the increasing consumption of both electricity and natural gas for 2015 through 2019. A range of 150.3-173.8 EUI was determined based on all available information. When comparing the average EUI from the ACRP 09-10 report, DAL facilities are in line with the average EUI. While this data point should not be considered without other analysis and tools, it does provide a good representation of overall performance relative to other similar comparable facility types.

Natural Gas Usage

Utility information for 2015 through 2019 was made available to the energy assessment team. It was assumed that due to pandemic-related issues and travel being reduced in 2020 that the data from 2020 and 2021 would not be representative of typical use, though the data was reviewed to understand base utility consumption, not dependent upon occupants. A review of the natural gas consumption revealed opportunities for additional study.

Examination of the natural gas data indicates significant consumption increase from 2016 through 2019. The natural gas utility consumption increased in 2016 to 2017 by 10,216 thousand cubic feet (MCF) or by approximately 25% and from 2017 to 2018 the natural gas consumption increased by another 1,860 MCF or an additional 5%. This data excludes the use of natural gas for cooking and food prep for the concessionaires. Natural gas consumption was compared to average temperatures during heating months to further analyze trends. **Figures 2 through 6** present the natural gas consumption during heating months compared to the average temperature.

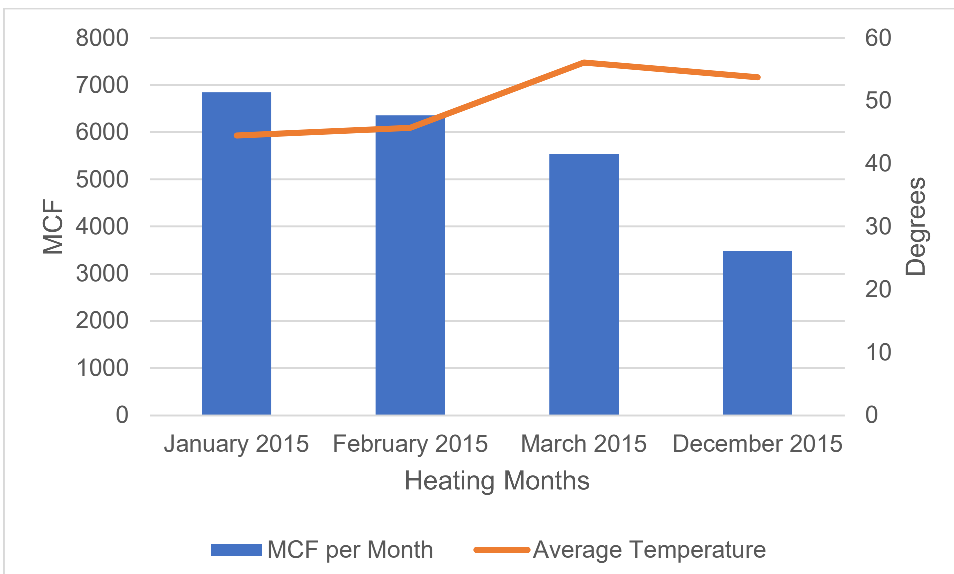

Figure 2. Average Temperature vs Natural Gas Consumption 2015

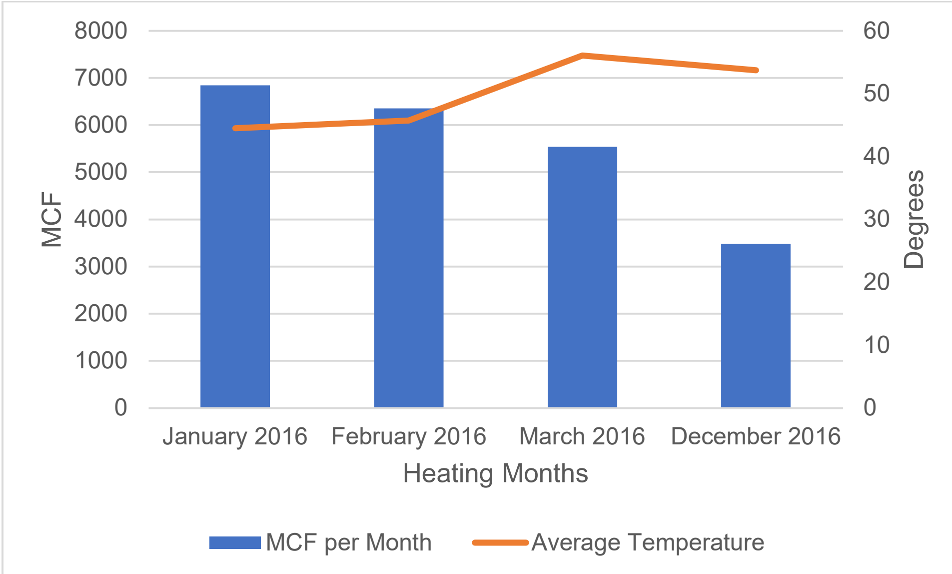

Figure 3. Average Temperature vs Natural Gas Consumption 2016

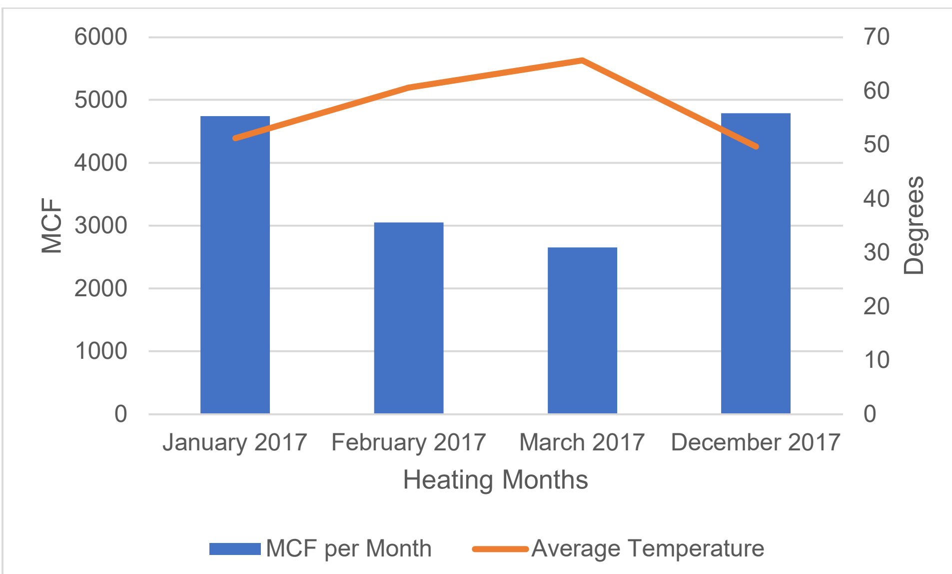

Figure 4. Average Temperature vs Natural Gas Consumption 2017

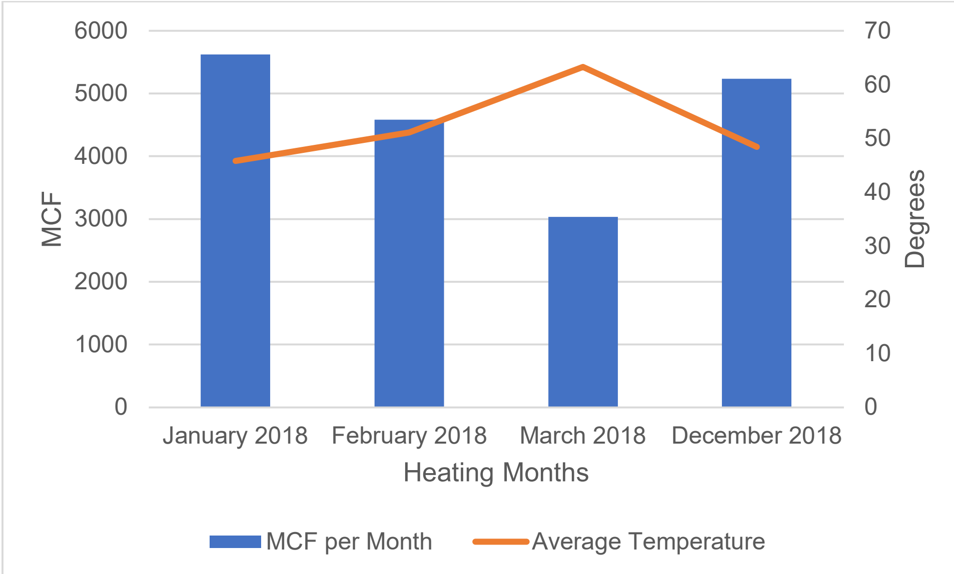

Figure 5. Average Temperature vs Natural Gas Consumption 2018

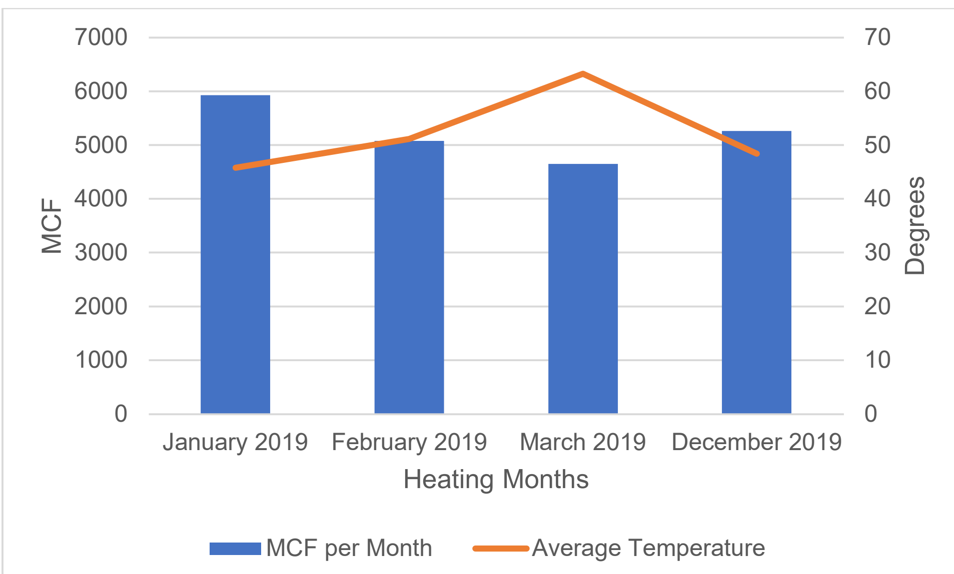

Figure 6. Average Temperature vs Natural Gas Consumption 2019

From review of the natural gas utility data compared with the average monthly temperatures, conceptually, as the average temperature for the month increases, the amount of natural gas consumed should inversely decrease. Generally the trend supports the aforementioned expectation, but there is a significant proportional increase that is noticed between 2016 and 2019. Based upon the understanding of construction activities along with operation of the buildings, there were no significant events that should have increased the amount of usage significantly. In fact, the usage between 2015 and 2016 was reduced by almost 23%, which can be attributed to the new modernization project which improved overall system efficiency and operation, leading to reduced natural gas consumption.

Based on observations, the assessment team identified the heating hot water system as a potential issue. It is recommended that additional historical information from the Building Automation System (BAS) regarding the heating hot water system be evaluated to provide some additional support as to why the additional natural gas was consumed during these time periods.

Electricity Usage

Study of the existing electrical utility information provides insight for the total facility energy consumption and usage. Specifically evaluating the monthly consumption on an annual basis with respect to the total heating degree days (HDD), cooling degree days (CDD) and total degree days (TDD) is an indicator of how the facility performs with respect to the outdoor temperatures. A degree day is the total difference between a mean temperature of 65°F. For example on a 80° day, the total number of CDDs would be 15; on a 30° day, the total number of HDDs would be 35. The summation of all CDDs and HDDs would yield the TDDs.

The following charts depict utility consumption performance from 2016 to 2019 per month with respect to the number of degree days. It is notable that the base loading of the Terminal and associated CUP increases by 8.4% CDD from 2,363,445 kilowatt hours (kWh) in 2016 to 2,581,728 kWh in 2019. This value indicates the minimum amount of energy consumed and excludes the impact of occupancy. This value is useful to assess, as examining it indicates that additional occupants or use is not the reason for additional consumption.

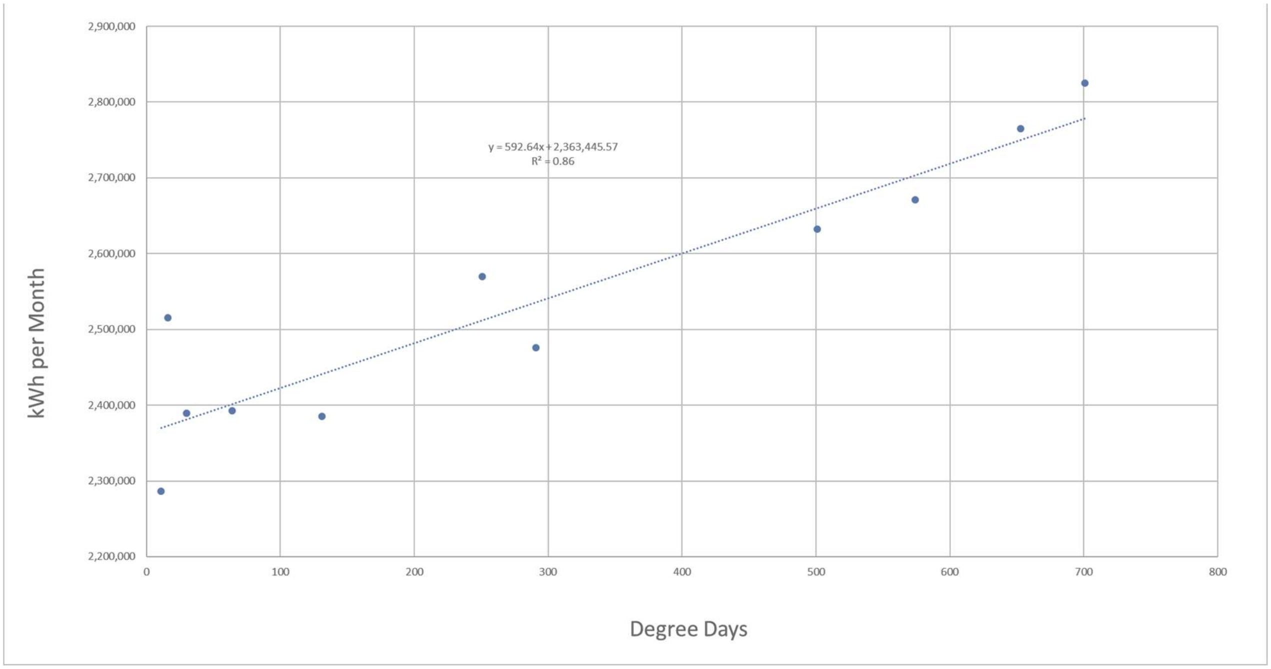

Figure 7. 2016 Electrical Consumption vs Cooling Degree Days

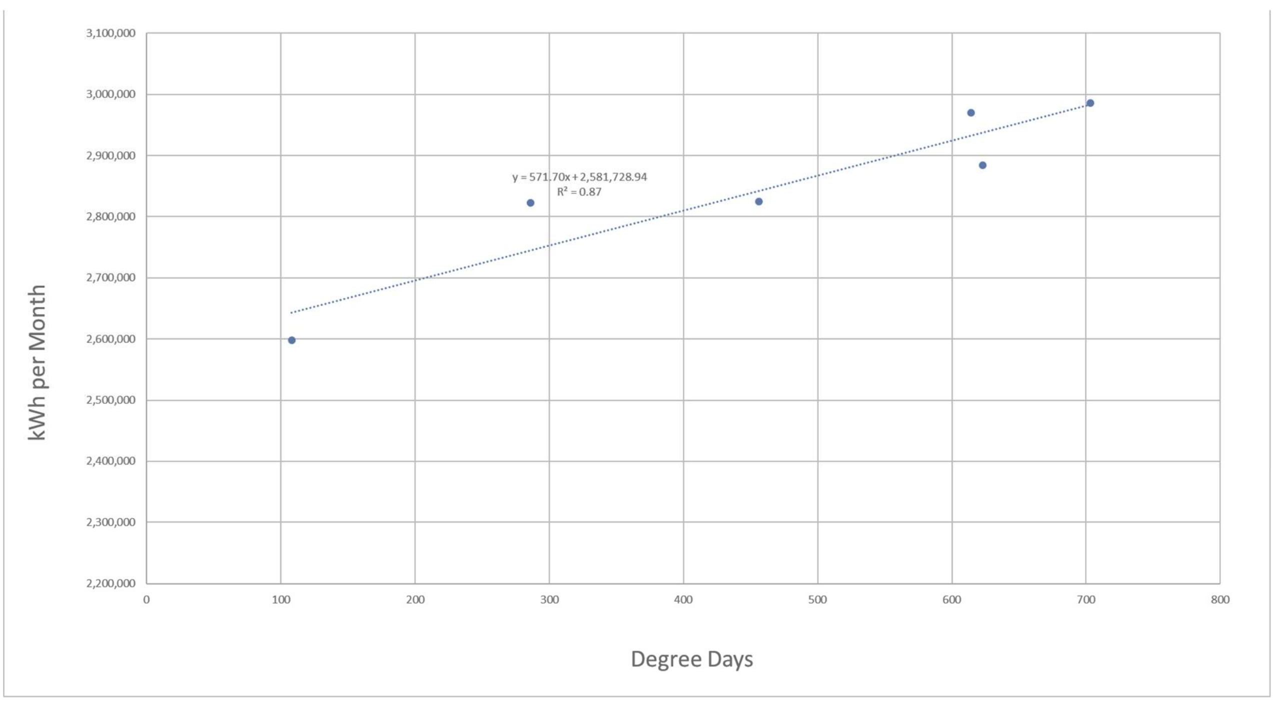

Figure 8. 2019 Electrical Consumption vs Cooling Degree Days

Based on information obtained during the assessment, that the thermal storage system was altered by removing the isolation valves, as well as temperature in the tank being adjusted, it is reasonable to assume that the change in operation resulted in an increase in energy consumption.

In addition to the adjustment of operation on the thermal storage system, there were other issues observed during the site investigation which may also be contributing to the reduced performance. The main issue that was discussed, which had no immediate resolution was the increase in chilled water temperature leaving the CUP and entering the building (approximately 10 degrees). The chilled water piping is routed through and underground utility tunnel. Additional investigation should be conducted to determine the cause of the temperature increase, but this may be contributing to the increased energy consumption.

Existing Facility Observations

All facility buildings were inspected for existing mechanical, electrical and plumbing systems. Observations were made on each system and notes and concerns regarding existing systems can be found below by building. Accompanying photographic documentation is provided in **Appendix C** for reference.

Terminal

Lighting

- Existing lighting appears to be mixture of T-3 and T-5 fixtures. Facilities in process of changing out fixtures to LED by means of lamp replacement. Large down lights in ticketing and baggage areas appear to be metal halide fixtures.
- Concourse lights are in the process of being changed out to more efficient fixtures.
- Reports from facility personal indicate that daylight harvesting controls and general lighting controls are not functioning properly.
- Lights in upper (ceiling) area of food court and concourse are running continuously all day and night and should be addressed.
- Lighting in Security/TSA area appear to all run continuously even when lanes are closed.

Heating & Cooling Systems

- Ticketing, Baggage Claim, Office and Security Areas are served by chilled water/hot water Temtrol air handling units housed on Level 3 above terminal.
- Outdoor air is provided by dedicated outdoor air units with increased carbon filtration.
- Basement level is served by chilled water/hot water Temtrol air handling units with dedicated outdoor air units housed in the basement.
- Data/server rooms are served by Liebert floor-mounted computer room air conditioning (CRAC) units. Thermostats are currently set ~54-60°F.
- Concourse area is served by similar chilled water/hot water Temtrol air handling units located on the upper concourse mechanical level (Level 3).
- Outdoor air units in concourse area are equipped with carbon filtration for jet fumes.
- Air terminal units, or variable air volume (VAV) boxes, serving all occupied spaces are equipped with hot water reheat coils.
- General exhaust fans are located in upper concourse mechanical area and are exhausted through louvers in building exterior.
- Exhaust fans for restaurant tenants are located on the concourse roof and are operated by tenant. It was observed that there were not as many makeup air units as exhaust fans, and there was not a requirement for tenants to provide makeup air.
- Mechanical spaces are conditioned with 4-pipe fan coil units.
- Elevator equipment rooms and electrical rooms are served by 2-pipe fan coil units.

- Sidewall prop fans are used to ventilate the lower concourse baggage carousel area. Radiant natural gas tube heaters are used to heat the space.
- Negative pressurization was noted in concourse areas near gates, facility personnel mentioned that temperature in gate areas elevates quickly when more than one gate is open.

Escalator Controls

- Multiple escalators and moving walkways throughout the building were noted to be operational 24 hours a day and 7 days a week (24/7).
- During occupancy, there were lengthy periods during which the escalators and moving walkways were not utilized.

Baggage Conveyor System

- Baggage conveyor systems was observed to be equipped with multiple 2, 3 and 5 horsepower motors which run constantly.
- During the site visit, sections of the belt were running with no baggage actually traversing the belts, other areas would see periods of up to 5 minutes between bags.

CUP

Boiler Room Building – Hot Water System

- Heating water is produced by (3) natural gas fire tube boilers. Two of the boilers were converted from fuel oil to natural gas.
- According to facilities, boilers are running at or above 85% efficiency.
- Each of the boilers has two pumps in a “primary/secondary” configuration per boiler.
- The “primary” (supply) pumps are equipped with variable frequency drives (VFDs) for speed control. The “secondary” (return) pumps are not equipped with VFDs.
- Controls logic were observed to energize new set of pumps for additional flow rather than staging on one pump or controlling VFD.
- Lead lag sequence would not de-energize if pump % fell below certain threshold

Chiller Building – Chilled Water System

- Chilled water system is served by (4) 1,400 ton constant speed Trane centrifugal chillers. One chiller is currently down for maintenance. Facility team stated that all 4 chillers had to be operational in order to maintain temperature in peak conditions.
- Chilled water pumping system is designed in a primary-secondary configuration with (4) 40 horsepower (HP)/2,100 gallon per minute (gpm) primary chilled water pumps that pump the chiller loop and (3) 200 HP/3500 gpm secondary chilled water pumps with VFDs that distribute chilled water to the terminal and other buildings. Secondary pumps are controlled off differential pressure. Pumps are in good working condition.

- Facility personnel indicate that significant fouling is occurring in chiller tubes due to chemical water treatment installed in the last few years.
- Chiller's schedules (equipment rotation) are assigned manually and adjusted daily by facility staff according to weather forecasts.
- All equipment with exception of the chillers is on an auto rotate schedule
- Chillers are not run 24/7, chillers are run to satisfy temperature setpoint in Thermal Storage Tank (TST) and chiller modes are controlled by TST. Building chilled water is then fed from the chillers and TST.
- Chillers are run in early morning hours to satisfy TST temperature setpoint and qualify for electricity discount from utility provider (9:00pm – 12:00pm).
- Facilities staff noted that all chillers and TST are needed to be able to maintain space temperatures in peak cooling season.
- Chilled water system/thermal storage tank controls have been modified from original installation.
- Facilities staff noted increased chilled water temperature entering the terminal building from the plant, citing a 10° increase from the time the chilled water leaves the plant until the time the chilled water enters the building.

Condenser Water System

- Condenser water system is served by (4) 100 HP/4200 gpm condenser water pumps and (2) cell cooling towers for a total of (4) four cooling tower cells. Each cell is factory rated for 1,056 tons.
- Cooling tower basin sweeper system did not appear to be operating.
- Noticeable buildup of scale/deposit on fill and in nozzles in/on cooling towers.

Thermal Storage Tank

- Thermal storage tank is designed to maintain at 38-44° from bottom to top respectively, current control setup is programmed to maintain all sensors at 38°.
- Isolation valves at tank were removed, which permits pumping through thermal storage tank when chillers are energized.

Administration Building

Lighting

- Lighting fixtures are high efficiency LEDs.
- Installation of occupancy sensors should be considered.
- Areas of interest: Room MER 120, MECH/ELEC 128, DINING, GYM.

Heating and Cooling System

- Building is served by a Daikin VRV system with heat recovery. (3) REYQ168 14-ton units and (1) REYQ144 12-ton condensing unit are located in rear of building.

- Indoor units consist of ceiling cassettes and wall mounted units throughout building. Each indoor unit is controlled by a dedicated thermostat.
- Room MER 120 is data room served by (2) Liebert DS Thermal Management units. Unit setpoints are 63° and 65° return air temperature.

Police Station

Lighting

- Lighting system was installed recently and utilizes LED fixtures and occupancy sensors.

Heating and Cooling System

- HVAC system was installed in 2014 and was equipped more recently with odor reducing carbon filtration.
- System and controls utilize energy efficient measures.

Airfield Maintenance Building

Lighting

- Lighting system utilizes high efficiency LED fixtures.

Heating and Cooling System

- Office area is served by (2) Trane split system AC units. Outdoor units are located on southern exterior wall and indoor fan coil units are located in 116 Mechanical Room.
- Data/Electrical Room served by Mitsubishi 2-ton minisplit with indoor wall mount unit. Portable OceanAire dehumidifier located in room is not functioning properly and was full when on site.
- Garage area served by roof mounted ventilation fans and radiant natural gas tube heaters.
- In addition to general exhaust, garage area is equipped with CARMON vehicle snorkel exhaust system with (4) vehicle exhaust connections.

Garage Area

Lighting

- Mood lighting and space lighting in sky walk appear to be running continuously.

Heating and Cooling System

- HVLS fans around garage appear to be running continuously.

Energy Conservation Measure Opportunities

ECMs are energy conservation measures or actions taken that reduce energy consumption of a particular piece of equipment or system to reduce the overall building energy use. ECMs below (color-coded green) are presented as recommendations aimed at conserving energy and reducing energy bills. This section also identifies areas of recommended further study (color-coded red).

Terminal & Concourse

- ECM: Downlights in terminal and concourse should be considered for replacement with LED fixtures for energy savings.
- ECM: Existing daylight harvesting system should be repaired and optimized to dim interior lighting in occupied passenger seating areas.
- ECM: Incorporate occupancy sensor to deenergize lighting when space is not occupied. Fixtures may also be considered for replacement or upgraded to LED fixtures.
- ECM: Utilize lighting control system to shut off lights in security during non-occupied/low occupancy hours.
- Further Study: Evaluate existing lighting system ability to shut down lighting serving inactive lanes during occupied hours
- ECM: It is acceptable to run data centers/equipment rooms at elevated temperatures (it is common to maintain these spaces at 85°). Consider increasing room temperature to reduce energy consumption and increase equipment life.
- Further study: Evaluate design and installation of outdoor air (OA) and exhaust air (EA). Perform an air balance to ensure the building is neutral or slightly positive to avoid drawing in unconditioned outdoor air.
- Further study: Determine applicability of motion sensors for use during occupied hours. Motion sensors would allow escalators to be deenergized during non-peak travel times.
- ECM: Deenergize escalators during non-occupied hours (i.e., install time of day system to shut down escalators between 12am-5am)
- Further study: Investigation should be performed to assess the feasibility of modifying controls for optimizing the baggage conveyor system.
- ECM: Utilizing controls/sensors, deenergize inactive sections of baggage conveyor system to reduce energy consumption when not being used.
- Further study: Investigation should be performed to assess loss of building pressure due to open jetways. Facilities personnel has indicated that building loses pressure and goes negative when multiple gates and jetways are open simultaneously.

CUP (Central Utility Plant)

- ECM: Heating water pumping controls should be modified to minimize pump usage and increase efficiency. Controls may be modified to utilize VFDs, a single lead pump may be energized at a reduced speed rather than staging on two pumps at full flow, when only 30% flow is needed.
- ECM: Primary chilled water and condenser water pumps all appeared to be controlling to constant speed. Recommend installing differential pressure control point from differential pressure (DP) sensor and allowing pumps to modulate flow. This strategy will allow pumps to reduce flow, while reducing energy consumption, as well as maintain more consistent water supply temperatures to the terminal.
- ECM: Recommend adding Variable Speed Drives (VFDs) to chillers to allow chillers to reduce energy consumption and minimize over pumping.
- ECM: Resolve issues with heat exchanger and enable free cooling whenever possible to save energy usage.
- Further study: Water treatment should be evaluated, significant buildup on cooling towers was also noted during observation. This issue should be addressed and resolved to increase chiller and cooling tower efficiency as well as useful life of each machine.
- Further study: Chilled water system should be evaluated to determine exactly what chilled water supply temperatures are, water flows and overall demand. It is suspected, due to several observations made by the facilities team, that the pumping system is over pumping the chillers, which in effect reduces the overall effectiveness of each chiller, reduces chilled water capacity and overall equipment life.

Administration Building

- ECM: Indoor Unit controls should be addressed including but not limited to evening/unoccupied temperature setback, thermostat setpoint limits, front end modification.
- ECM: Setpoints in MER 120 could be adjusted.

Airfield Maintenance

- ECM: Occupancy sensors or time-of-day timers could be added in the garage space to reduce usage when bays are not being used.
- ECM: Humidity issues in data room should be addressed. Humidifier should be emptied when full. Ductwork insulation and piping insulation in 116 Mechanical Room should be repaired where damaged for test port installation. Rusty fan cover on condensing unit should be replaced. Radiant heater thermostats should be relocated for more accurate occupied space reading.

Additional recommendations proposed for further study:

- Chilled water system operation and temperature issues should be investigated as well as significant fouling in condenser water system and cooling tower operation.
- Chilled water and thermal storage controls sequences should be investigated for energy saving measures.

Further analysis specifically on the changeout of LEDs and the addition of variable speed drives to the chillers and primary chilled water pumps can be found in **Appendix A**. An evaluation of the impact of all relevant Energy Conservation Mearsures and related payback period is presented in **Appendix B**. Typical images and site conditions can be seen in **Appendix C.**

APPENDIX A: Alternate Model Comparison

Comparison 1 below shows results of complete LED lighting changeout. Due to less heat to the space, there is savings in all categories excluding heating. A 30% savings in interior lighting is observed equating to significant savings on electric consumption. An overall savings of 13% is observed.

Comparison 2 shows savings from the addition of variable speed drives to the chillers and primary chilled water pumps. Savings of 39% on cooling electricity and 15% on pump electricity lead to an overall savings of almost 10%.

		Baseline		Comparison 1		Comparison 2	
				LED CHANGE-OUT		VARIABLE SPEED DRIVE CHILLERS & PRIMARY PUMPS	
		Energy (kBTU)	**% of Total**	**Energy (kBTU)**	**% Improve**	**Energy (kBTU)**	**% Improve**
Heating	*Electricity*	703,498	2%	1,107,979	-57%	702,588	0%
	Natural Gas	501,935	1%	482,240	4%	501,499	0%
Cooling	*Electricity*	6,361,425	14%	5434,062	15%	3,864,146	39%
Interior Lighting	*Electricity*	5,200,899	11%	3,651,541	30%	5,200,899	0%
Interior Equipment	*Electricity*	4,343,286	9%	4,544,621	-5%	4,343,286	0%
Fans	*Electricity*	3,730,409	8%	3,252,548	13%	3,729,546	0%
Pumps	*Electricity*	3,942,748	8%	2,856,029	28%	3,354,021	15%
Heat Rejection	*Electricity*	234,253	0%	206,330	12%	225,979	4%
	Water	21,865,882	47%	19,355,921	11%	20,584,235	6%
Summary	*Electricity*	24,516,519	52%	21,053,110	14%	21,420,465	13%
	Water	21,865,882	47%	19,355,921	11%	20,584,235	6%
	Natural Gas	50,1935	1%	482,240	4%	501,499	0%
	Total	46,884,337	100%	40,891,271	13%	42,506,199	9%

APPENDIX B: Energy Conservation Measures Results

The table below shows proposed energy conservation measures and calculated payback period in years. Assumptions made in calculations can be found in table notes.

ENERGY CONSERVATION MEASURES														
SERVICE / UTILITY		QTY	EXISTING UNIT POWER (W)	EXISTING CONSUMPTION (kW)	ANNUAL CONSUMPTION (kWh)	ENERGY RATE ($/kWh)	ANNUAL COST ($)	NEW POWER CONSUMPTION (W)	INVESTMENT/ REPLACEMENT COST($)	NEW UTILITY COST ($)	ANNUAL SAVINGS ($)	ANNUAL SAVINGS (%)	PAYBACK PERIOD (Years)
TERMINAL LIGHTING to LEDs [1]		1,400	38	53	466,032	0.02938	$13,692	20	$210,000	$7,296	$6,396	47%	28.8
CONCOURSE LIGHTING FIXTURES	2x2 Troffers	156	48	7	65,595	0.02938	$1,927	25		$1,004	$923		
	4' Strip Lights	484	54	26	228,951	0.02938	$6,727	25		$3,114	$3,612		
	4" Recessed	189	32	6	52,980	0.02938	$1,557	19		$924	$632		
	8" Downlights	150	18	3	23,652	0.02938	$695	12		$463	$232		
	TOTAL [1]						$10,905		$149,000	$5,505	$5,400	50%	27.1
LIGHTING OCCUPANCY CONTROLS[2]					8,760,000	0.02938	$257,369		$24,000	$231,632	$25,737	10%	0.9
DAYLIGHT HARVESTING CONTROLS[3]							$10,905		$10,000	$7,961	$2,944	27%	3.4
ESCALATOR MOTION SENSING[4]				75	408,644	0.02938	$12,006		$15,000	$9,004	$3,001	30%	5.0
THERMAL STORAGE SYSTEM ISSUES[5]							$847,067		$300,000	$657,295	$189,772	22%	1.6
WATER TEMPERATURE ISSUES[6]									$40,000				
WATER QUALITY ISSUES[7]													
BUILDING PRESSURE ISSUES[8]									$35,000				
ADMIN. BLDG CRAC UNIT SETPOINT [9]							$43,658		$0	$41,663	$1,995	5%	0.0
ADMIN. BLDG SYSTEM SETPOINT [10]							$43,658		$0	$41,450	$2,208	5%	0.0
AIRFIELD MAINT. BLDG HEATERS [11]					11,523	0.0767	$884	8,642	$1,000	$663	$221	25%	4.5

(1) REPLACEMENT COST BASED ON $150.00/ FIXTURE REPLACEMENT; INCLUDES ALL LIFTING EQUIPMENT AND TYPICAL MARKUPS; QTY AND EXISTING POWER ARE ESTIMATES.

(2): INVESTMENT BASED ON 120 HRS OF LABOR AT $200/HR TO RE-PROGRAM LIGHTING CONTROLS; CALCULATION BASED ON 1,000,000 SQ. FT. @ 1W/SQ.FT.; EFFORT AND COSTING SHOULD BE OBTAINED FROM LOCAL LIGHTING CONTROLS VENDOR.

(3): INVESTMENT BASED ON 50 HRS OF LABOR AT $200/HR TO RE-PROGRAM DAYLIGHT HARVESTING CONTROLS IN CONCOURSE; EFFORT TO PROGRAM EXISTING DHC TO BE OBTAINED FROM LIGHTING VENDOR

(4): CALCULATION BASED ON 100HP MOTOR OPERATING AT 16 HR/DAY; 30% SAVINGS BASED ON INSTALLATION OF MOTION SENSING DEVICE AND INTERMITTENT MOTOR OPERATION TRIGGERED BY MOTION.

(5): ASSUMES SAVINGS COME FROM RUNNING CHILLERS AT TIMES WHEN RATES ARE DISCOUNTED TO $0.02938/KWH; CONTACT LOCAL CONTROLS CONTRACTOR FOR FURTHER DETAIL; $ 300,000.00 INVESTMENT ASSUMES WORK ON CONTROLS, VALVING, COOLING EQUIPMENT AND THERMAL STORAGE TANK.

(6): EVALUATION AND TESTING + RECOMMENDATIONS (TAB CONTRACTOR REQUIRED); DOES NOT INCLUDE REPAIR COST.

(7): MUST BE ADDRESSED. FOULING AND WATER ISSUES IN TOWER AND CHILLERS ARE ROBBING EFFICIENCY AND CAUSING ADDITIONAL MAINTENANCE. FURTHER INVESTIGATION SHOULD BE CONDUCTED TO DETERMINE POTENTIAL SAVINGS.

(8): TEST AND BALANCE OF ALL MAJOR SYSTEMS AND EVALUATION OF CONCOURSE PRESSURIZATION; PAYBACK CONTINGENT ON BUILDING PRESSURIZATION. ADDITIONAL BENEFITS OF POSITIVE (CORRECT) PRESSURIZATION INCLUDE: OCCUPANT COMFORT, IMPROVED HUMIDITY CONTROL, AND REDUCED ODOR MIGRATION.

(9): SAVINGS BASED ON INCREASED CRAC UNIT COOLING SETPOINT IN ADMIN BLDG IT ROOM. CURRENT SETPOINT = 62°F, PROPOSED SETPOINT = 70°F. ZERO COST OF REPLACEMENT.

(10): SAVINGS BASED ON THERMOSTAT CONTROLS LOCKOUT AT 72°F. OCCUPANT COMFORT SHOULD BE TAKEN INTO ACCOUNT.

(11): ANNUAL CONSUMPTION ESTIMATE IN THERMS; ENERGY RATE = $0.0767/THERM. REPLACEMENT COST INCLUDES INSTALLATION OF OCCUPANCY SENSORS IN OCCUPIED SPACES.

APPENDIX C: Existing Equipment and Typical Building System Images

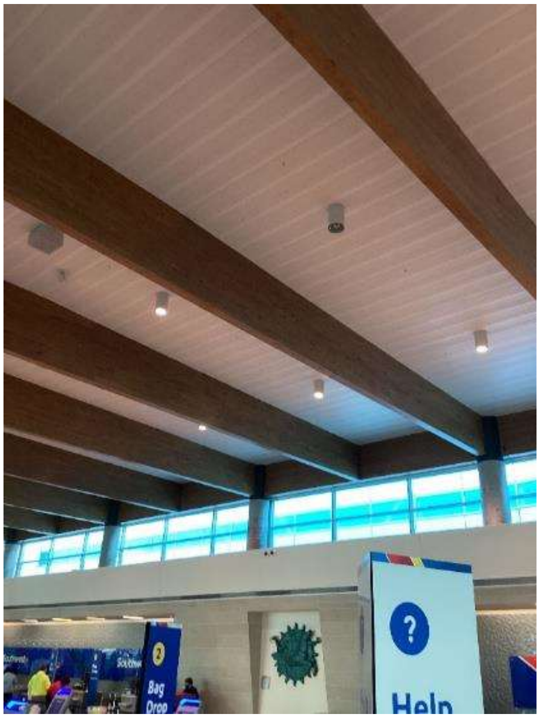

Image 1: Drop Lighting in Terminal Ticketing Area

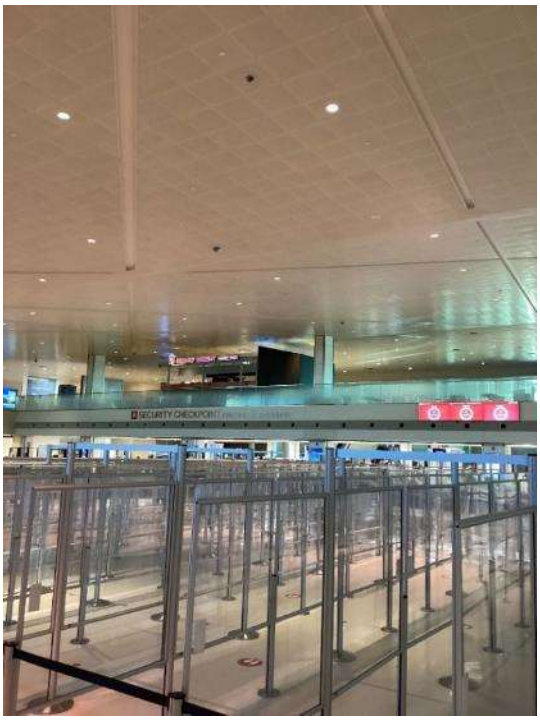

Image 2: Typical Lighting and Air Distribution in Terminal Security Area

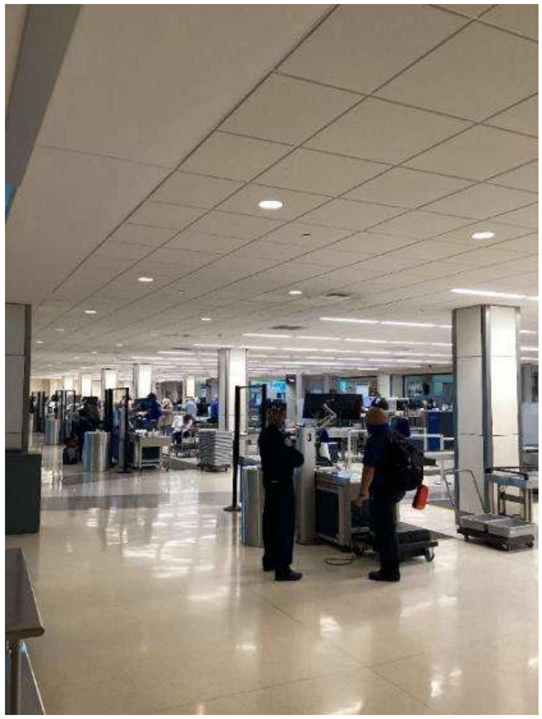

Image 3: Lighting in Security Checkpoint Area

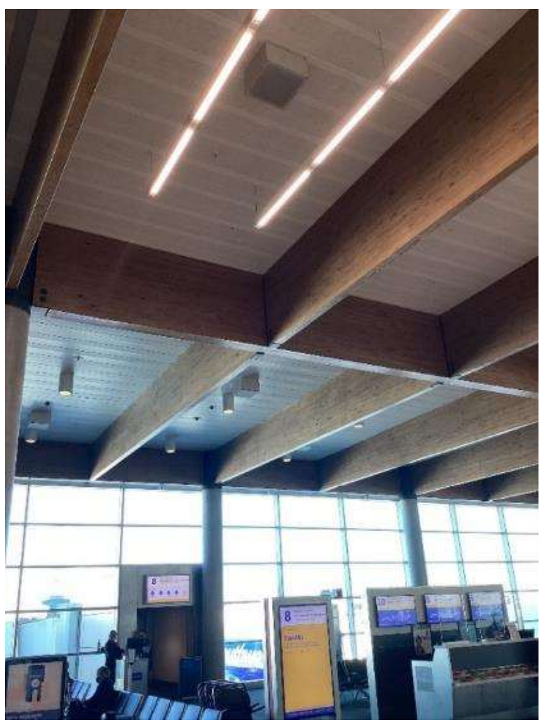

Image 4: Typical Lighting in Concourse

Image 5: Typical Lighting in Concourse (2)

Image 6: Typical Data/Computer Room Unit

Image 7: Typical Hot Water Boiler

Image 8: Heating Water Pumps

Image 9: Chillers

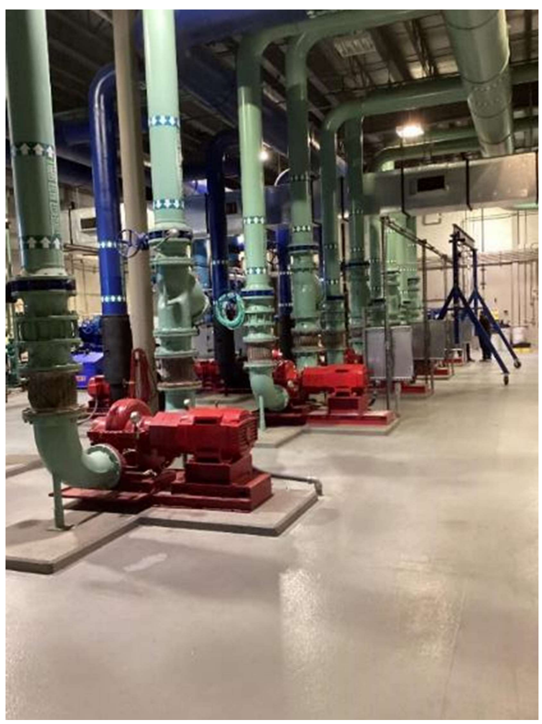

Image 10: Primary Chilled Water and Condenser Water Pumps

Image 11: Secondary Chilled Water Distribution Pumps (with VFDs)

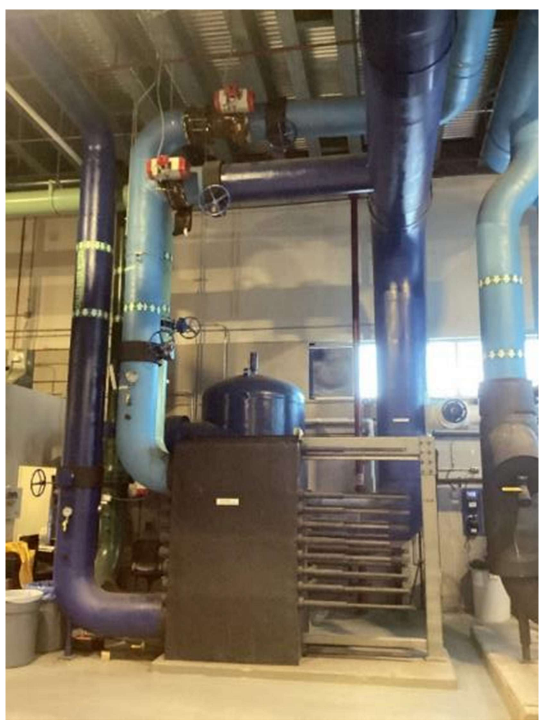

Image 12: Unused Heat Exchanger

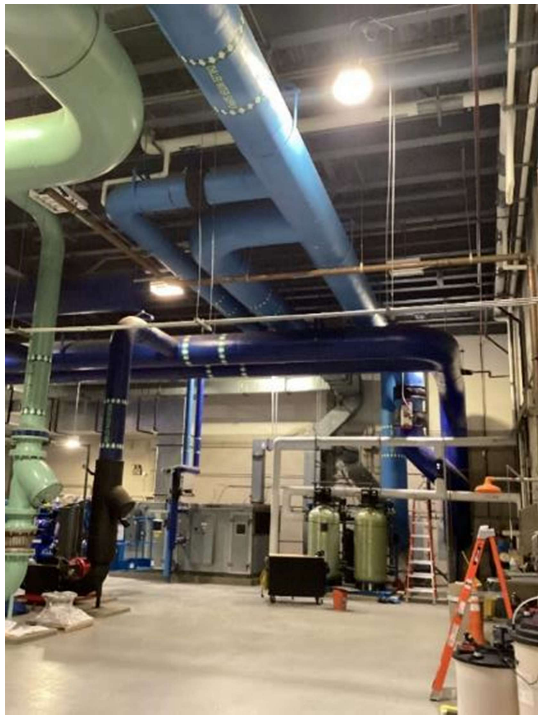

Image 13: Piping at Thermal Storage Tank

Image 14: Cooling Towers

Image 15: Typical Outdoor Air Unit

Image 15: Typical Chilled Water/Hot Water Air Handling Unit

Image 16: Airfield Maintenance Building Data Room De-Humidifier (Full)

Image 17: Airfield Maintenance Garage Building

Image 18: Administration Building VRF Condensing Units

Image 19: Typical VRF Air Handler in Admistration Building

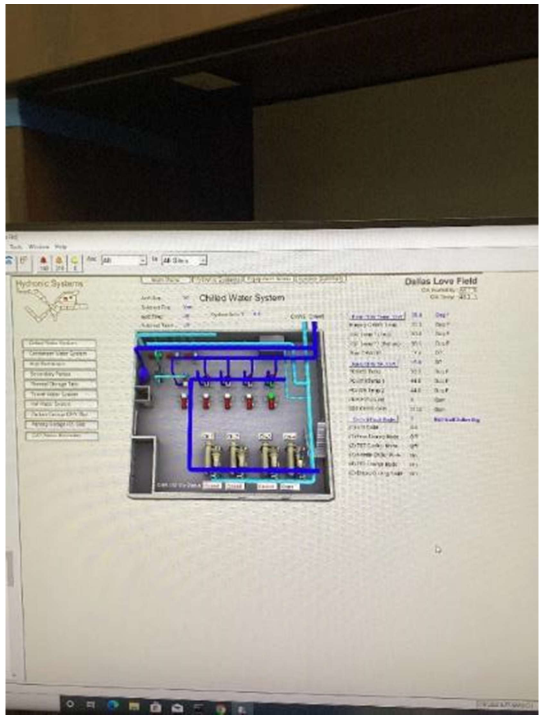

Image 20: Chilled Water System Controls

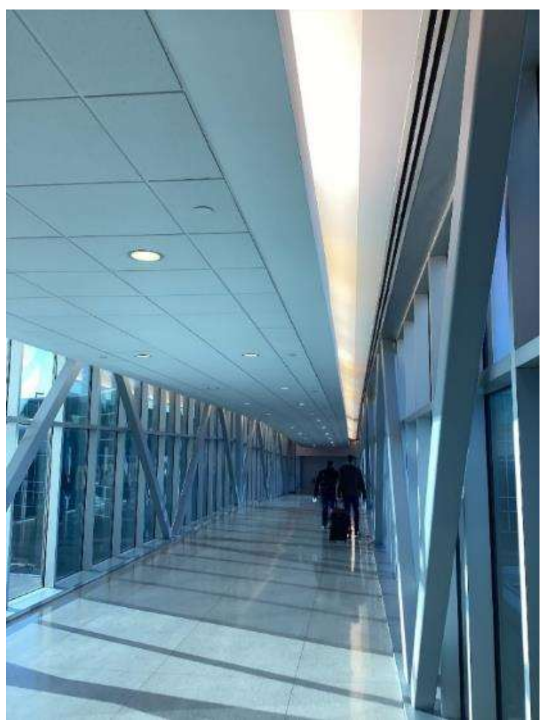

Image 21: Skywalk Lighting

Image 22: Lighting and Air Distribution in Food Court Area