

## BUILDING SYSTEMS AND ENVELOPE MANAGEMENT WORK PLAN

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### I. Introduction

The Kendeda Building for Innovative Sustainable Design was designed and constructed to meet the requirements of the Living Building Challenge (LBC) version 3.1. The material covered in this document is intended to inform and instruct staff to operate the building to LBC standards. The document is also designed to educate stakeholders, building occupants, and visitors of key sustainable systems, as well as how they function and operate.

This work plan covers the standard operating procedures for all Mechanical, Electrical, Plumbing, Fire Protection, Vertical Transportation, and Envelope disciplines (collectively referred to as “building systems and enclosure”) within the Kendeda Building. This documentation also outlines the operations and maintenance (O&M) approach to maintaining the Kendeda Building per the design intent to meet the LBC 3.1 certification requirements.

Requirements and guidance for building systems and enclosure are found in the Energy, Water, Materials, and Health and Happiness Petals of the LBC. The Kendeda Building contains mechanical systems that will be reliable and safe while utilizing power generated only from its onsite renewable energy source. The sustainable plumbing system is designed to produce potable water using collected rainfall. The building promotes occupants’ well-being by using materials that are ecologically restorative and contain minimum amounts of pollutants.

## II. Contact Information

- For information or maintenance questions contact Marlon Ellis, Area Six Maintenance Manager:
  - Phone: 404-861-9852
  - Email: [mellis61@gatech.edu](mailto:mellis61@gatech.edu)
- For Emergencies, please contact:
  - Area Six Maintenance Manager during normal business hours
  - Campus Police @ 404-894-2500 during after hours, campus holidays, or weekends

## III. Expectations

This work plan includes an overview of key sustainable building systems, their locations, and how each system functions. This document serves as the basic guideline for how each system is monitored, operated, and maintained within each system assembly.

### *General O&M*

The Area Six Maintenance Manager has primary facility oversight and responsibility. This includes managing all O&M aspects of building systems and components, including:

- Managing / coordinating an O&M team that consists of designated staff along with additional internal and external support,
- Using various tools including Building Automation System (BAS), Fault Detection and Diagnostics (FDD)/Analytics, and Computerized Maintenance Management System (CMMS).
- Coordinating the updating of and revisions to this work plan.

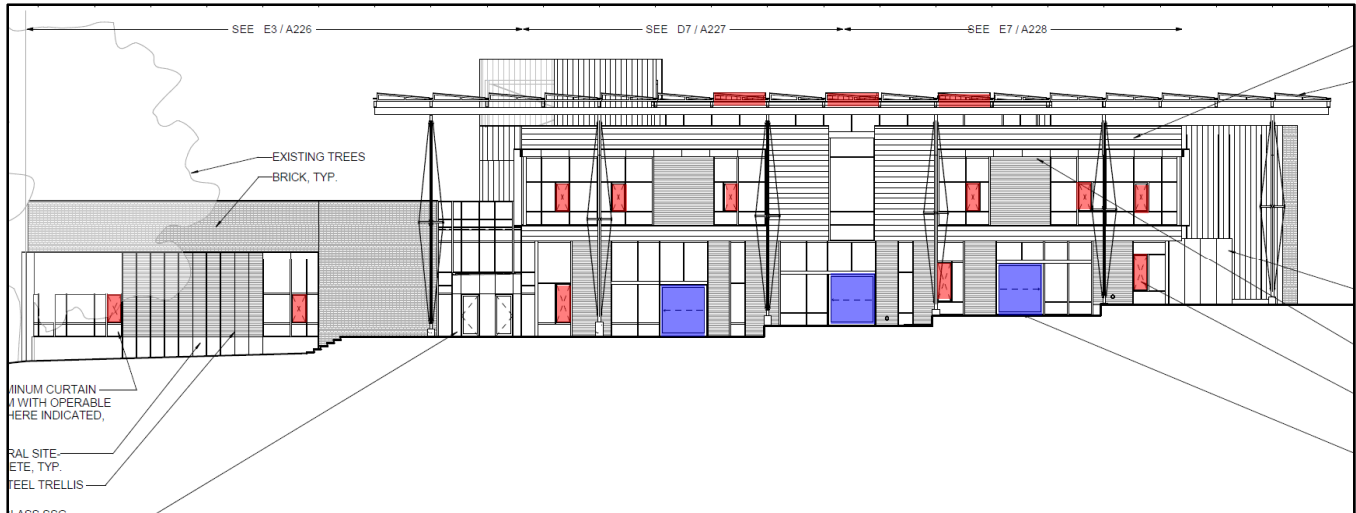
### *Approach*

- All activity to be compliant with the LBC v. 3.1 standard.
- All maintenance activities to be performed using industry best practices, along with manufacturers' recommendations (refer to Operations and Maintenance Manuals for each piece of equipment as provided by Skanska during close-out of the construction project).
- Maintenance activities shall maintain code compliance and will be compliant with the LBC v. 3.1 Red List requirements, as well as the guidance provided by the International Living Future Institute.
- On-going commissioning will be performed to maintain LBC v 3.1 standard. This shall involve the Commissioning Agent (Darren Draper of Epsten Group) through the Performance Period (currently scheduled from December 2019 through December 2020) via remote access to the JCI Metasys BAS as well as the HEPTA graphics package and FDD System.

## IV. Enclosure

### *Operable Windows*

The operable windows are automatically controlled as part of the BAS with local user overrides. These windows are a part of a natural ventilation strategy and their proper operation impacts energy performance and building IAQ.



**West Elevation Operable Windows (red) and Lift and Slide Doors (blue)**

### Operational Intent

Windows automatically open when outdoor conditions are favorable for free, natural cooling. The windows also open at night to allow for night flushing to improve ventilation and pre-cool the building.

Each window has a manual override as required by the LBC; however, the BAS overrides the manual condition and returns the window to its default position based on the current outdoor conditions after 90 minutes (time delay is fully adjustable through BAS).

### Governance of Manual Override

The Area Six Maintenance Manager is the primary person responsible for governing the manual operation of the windows. However, the position of each window control module is known through the BAS.

Once the manual switch is depressed, the override open timer begins. Additionally, unlike a traditional light switch, depressing the switch again RESTARTS the timer, it does NOT close the window. This is very important to understand.

### *Manually-Operated Exterior Doors*

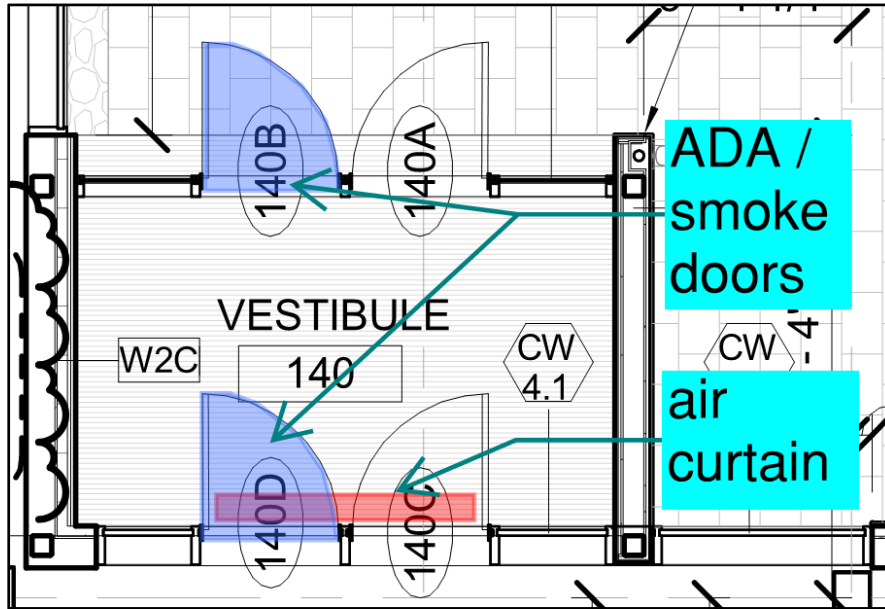
The lift and slide doors are located on the west side of the ground floor facing the building's porch and the Eco-Commons. These doors are manually controlled and can only be opened using a handle available from the Area Six Maintenance Manager.

They are an optional part of the natural ventilation system, but their proper operation is critical to the energy performance of the facility. A lift and slide door left in the OPEN position creates a significant energy use risk if not corrected quickly when outdoor conditions are not favorable (hence the requirement to obtain the door handles from the Area Six Maintenance Manager). However, when open these doors provide a program benefit to Georgia Tech (e.g., a seamless indoor/outdoor space for events).

### Main Entry Vestibules/Doors

Main public entrances include vestibules. There are automatic doors on each side of each vestibule for Americans with Disabilities Act (ADA) access. Four (4) of the eight (8) are part of the smoke control/evac system. These ADA/smoke evac doors open automatically during a smoke control event.

The basement vestibule neither includes ADA doors nor are they part of the smoke evac system. Each vestibule contains an air curtain on the exterior side of the most interior door and at the exterior door exiting onto the green roof. These energize any time the interior doors in the vestibule open to minimize infiltration.



Typ 1st Floor Vestibule

### TPO Roof (Main Roof and Clerestory Roof)

The low-slope roofing system, along with the photovoltaic array, is an important part of the rainwater harvesting system and therefore critical to the success of the LBC net-positive water requirement. Despite this unique situation, the roofing system is a traditional low-slope membrane system with crickets to primary drains with adjacent emergency overflow drains. The TPO roofing membrane does have an NSF coating to allow for the water capture and treatment to potable water.

## *Automated Shades*



**Typical Automated Blind Location**

The motorized blinds are on the exterior of the building, currently along the windows on the west elevation only. These blinds are self-controlled, i.e., automated, based on available sunlight. These devices integrate with the BAS and tie in with the FD&D system. Local override capability is in place to temporarily modify the position of the blinds. These devices are covered in the design documents under specification section 107113.

## **V. Elevator Conveying System**

Thyssenkrupp Elevator Corporation provided a 2 traction passenger elevator car and system rated for 3,500LBS capacity. The elevator car has been designed as a “Class A” freight loading unit which has 42” front and rear loading access doors. The elevator car is on a slide guide type that has an operating speed of 150 FPM with regenerative breaking. The system is also machine room-less type.

### *Elevator Cab Features*

- Cab type flat steel walls
- 8'-10"Ht metal pan ceiling with 9 LED fixtures
- Stainless steel cab ceiling/door/handrail with brushed finish
- Tile flooring in cab
- Two (2) ¼"x2" continuous flat handrails
- 2-speed exhaust fan
- Top emergency exit with car-top exit switch
- Total cab weight 3,610LBS (rated to hold another 3,500LBS capacity)

### *Elevator System Components*

- Full load mass 12,819LBS

- Hoist cables six (6) 8mm / 8x19 Warrington IWRC
- Governor cable one (1) 6.5mm / 8x19 Warrington IWRC
- Compensation chain

*Energy requirements*

- Elevator metering EM-105
- TAC32-T operation

*Management of O&M Contracts for Elevator Systems*

- Responsible parties – Utilities & Maintenance / Area Six Maintenance Manager
- Plan for service outages

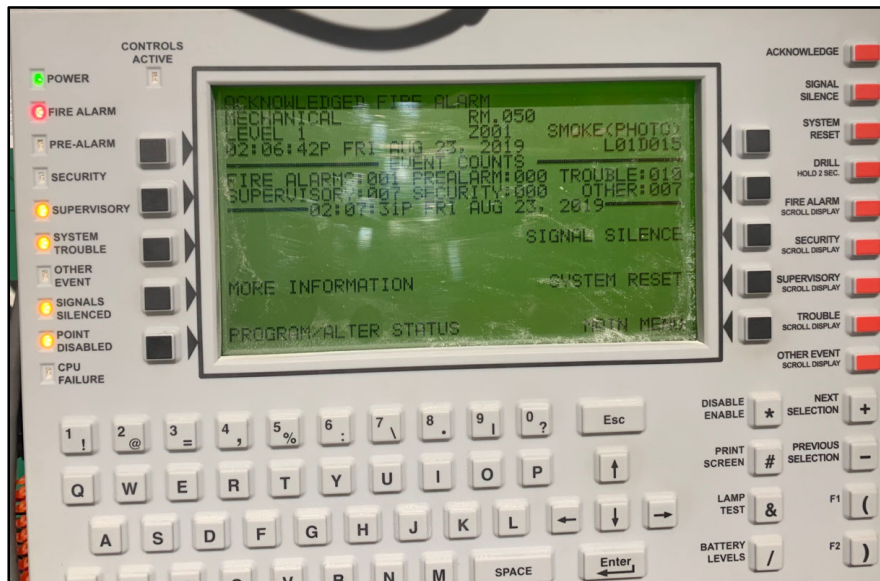
**VI. Fire Protection / Sprinkler System**

The fire sprinkler system is fed from the 8” water main along State Street which is tapped by 6” fire protection mains with two (2) vaults installed by the City of Atlanta. The 6” main enters the building in Fire Riser Room 055.

Each floor is one zone. Each zone has a zone isolation valve with a tamper switch, flow switch and fire department test station. The piping serving the bike storage is the only portion of the system that is dry-type.

**VII. Fire Alarm / Smoke Control**

The fire alarm system is Notifier by Honeywell. The main fire alarm panel is located in Main Electrical Room.



**Notifier Main Control Panel**

The fire alarm remote annunciator panel is located in the 1<sup>st</sup> Floor, Ferst Street entrance vestibule.



**FA Remote Annunciator**

The smoke control panel is located adjacent to the 1st floor main lobby outside of Conference Room 190. This control panel is for Fire Department override of the smoke controls including the clerestory windows, the ADA vestibule doors, which both open in a smoke event, and the Atrium and Auditorium ceiling fans.

In general, there should not be any hands-on activities with the fire alarm system that does not involve the Georgia Tech Fire Marshals' Office. If a "trouble" or "fault" condition exists, then the remote panel will have an audible alarm. The Area Six Maintenance Manager should notify the Georgia Tech Fire Marshal of this condition.



**Smoke Control Override Panel**

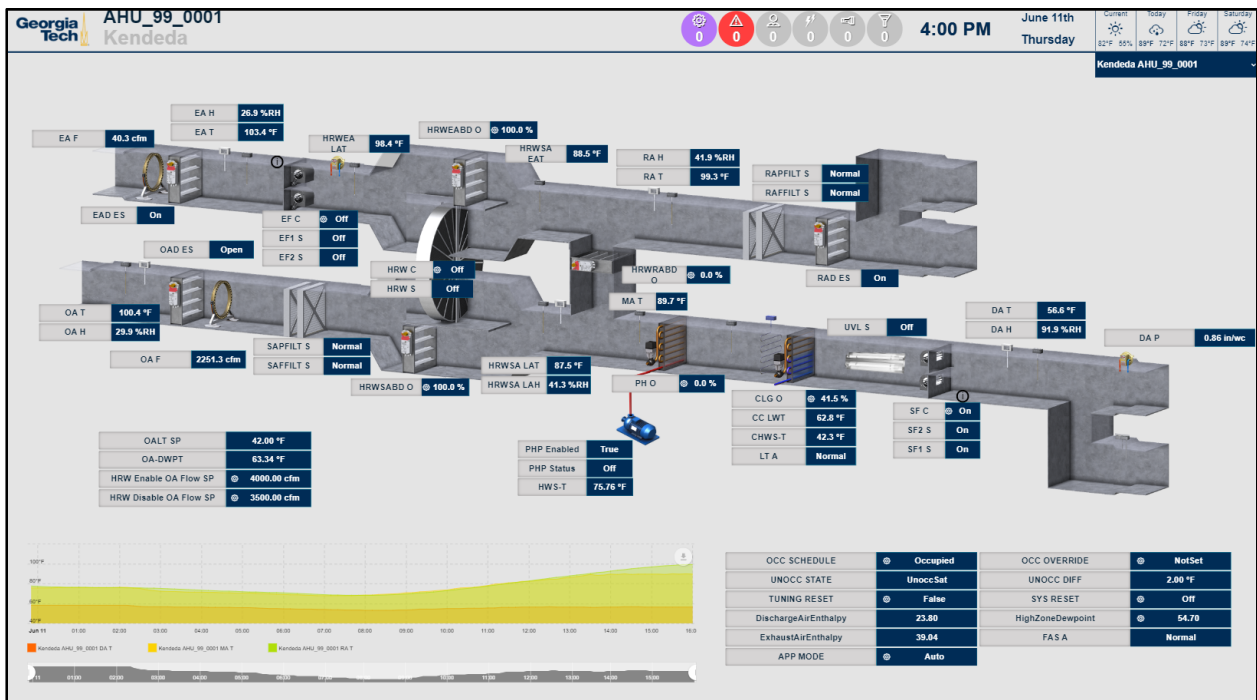


## VIII. Mechanical

### AHU-99-0001 Dedicated Outside Air Energy Recovery Unit

The Trane CSAA035UB Performance Climate Changer with Total Energy (sensible and latent) Recovery Wheel is the dedicated outside air treatment unit for the entire facility with the exception of the Auditorium. The unit is located on the high roof and is fully controlled by the BAS. The unit includes an exhaust fan for purposes of maximizing energy recovery and building pressure stability. Below is other pertinent information about this unit:

- Design max outside airflow: 11,100 Cubic Feet per Minute (CFM)
- Total static pressure: 2.311/4.589
- Cooling coil: 58.6 Ton/703,730 BTU
- Supply fan: variable-frequency drive (VFD)/Starter
- Exhaust fan: VFD/Starter
- Aluminum SEMCO energy wheel
- Single use horizontal coil
- Stainless steel drain pan



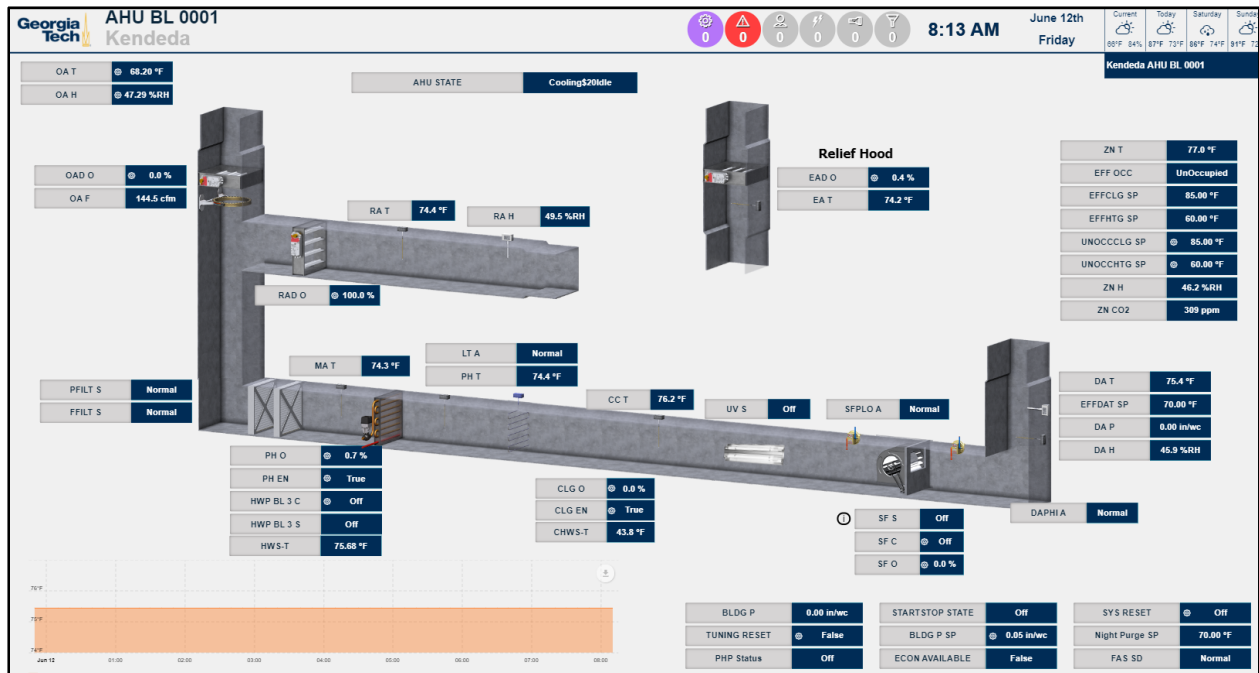
View of AHU-99-0001 BAS Graphic

### AHU-BL-0001 Auditorium Air Handling Unit

The Trane CSAA014UA Performance Climate Changer only serves the Auditorium and acts as a single zone, variable flow unit with preheat and chilled water cooling coils. The unit is located in the Basement Mechanical Room and is fully controlled by the BAS. Below is other pertinent information about this unit:



- Actual airflow: 4000 CFM
- Total static pressure: 3.373
- Supply fan: VFD/Starter
- Horizontal coil, type 5w, with aluminum fins
- Controls, actuators, sensors, interfaces, flow measuring devices, etc. are not by Trane
- Piping packages and control valves are not by Trane
- Air handler fans have 2" spring internal isolation, which is provided in lieu of any external vibration isolation curbs or rails
- Vibration isolation curbs are NOT provided by Trane
- Fire/smoke devices are not by Trane



**View AHU-BL-0001 BAS Graphic**

### *Heat Recovery Chillers/Pumps*

Two (2), 30 ton AquaSnap water cooled scroll chiller units (410-A refrigerant) are the only heating source for the building and are in place in lieu of traditional gas-fired boilers (not permitted under LBC). There are six (6) pumps associated with this plant.

#### Primary CHW Pumps CWP-BL-0001 and 0002

These pumps push chilled water to the building when the chillers are in operation OR when the campus chilled water plant cannot satisfy the building differential pressure (DP) setpoint. Pump speeds are controlled based on the chilled water (CHW) loop differential pressure.

#### Evaporator Pumps CWP-BL-0003 and 0004

These pumps push water through the evaporator side of the chillers only when the chillers are in operation. The pumps are configured with the chiller on a 1:1 one ratio though they share a common header (not dedicated pump-to-chiller arrangement). These pumps are off whenever the chillers are off. Pump speeds are controlled based on the evaporator barrel pressure drop requirement.

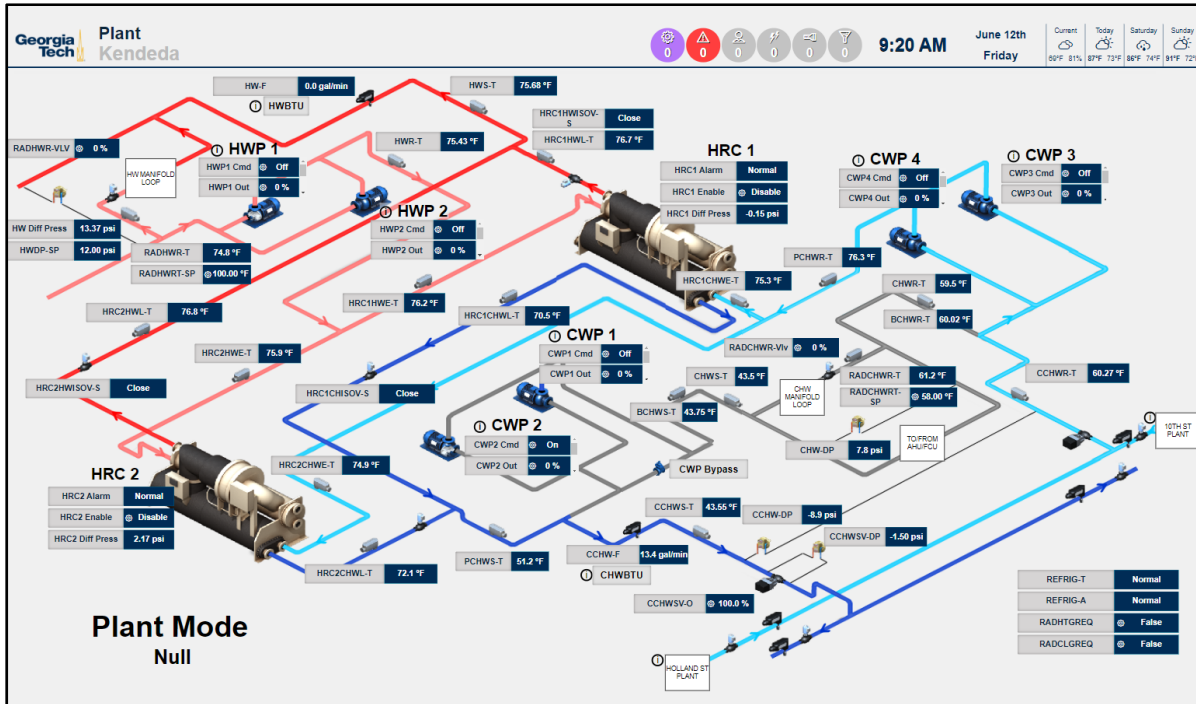
#### Condenser/HHW Pumps HWP-BL-0001 and 0002

These pumps push water through the condenser side of the chillers and the rejected compressor heat is used for heating hot water throughout the building, specifically within the radiant flooring (see later sections). The speeds are controlled based on HHW loop differential pressure. Below is other pertinent information:

- Chillers will operate down to 10% load with 55 degrees chilled water supply
- Cooling capacity: 35.06 Tons
- Heating capacity: 543,600 BTU/hr
- Total power: 37.94 kW
- Cooling efficiency: 1.081 kW/Ton
- Heating efficiency: 4.203 kW/kW
- Scroll compressor with R-410A refrigerant with direct drive hermetic motor and motor controls
- Evaporators will have 150 psig working pressure rated for variable chilled water flow certified to operate at minimum design flow
- EWT 50.02 F and LWT 45.00 F
- Fluid Flow 167 gpm

Condensers will have a minimum waterside rating of 150 psig working pressure with water velocity tubes that have maximum design flows of 10fps. Below is other pertinent information:

- Condenser loop: primary hot water loop (2 HWP Pumps)
- EWT 103.00 F and LWT 119.35 F
- Fluid flow: 67.00 gpm
- Pressure drop: 4.12 ft. H<sub>2</sub>O
- When cooling demand is low or non-existent, the plant rejects chilled water back to the main campus chilled water system



**View of CHW/HHW Plant BAS Graphic**

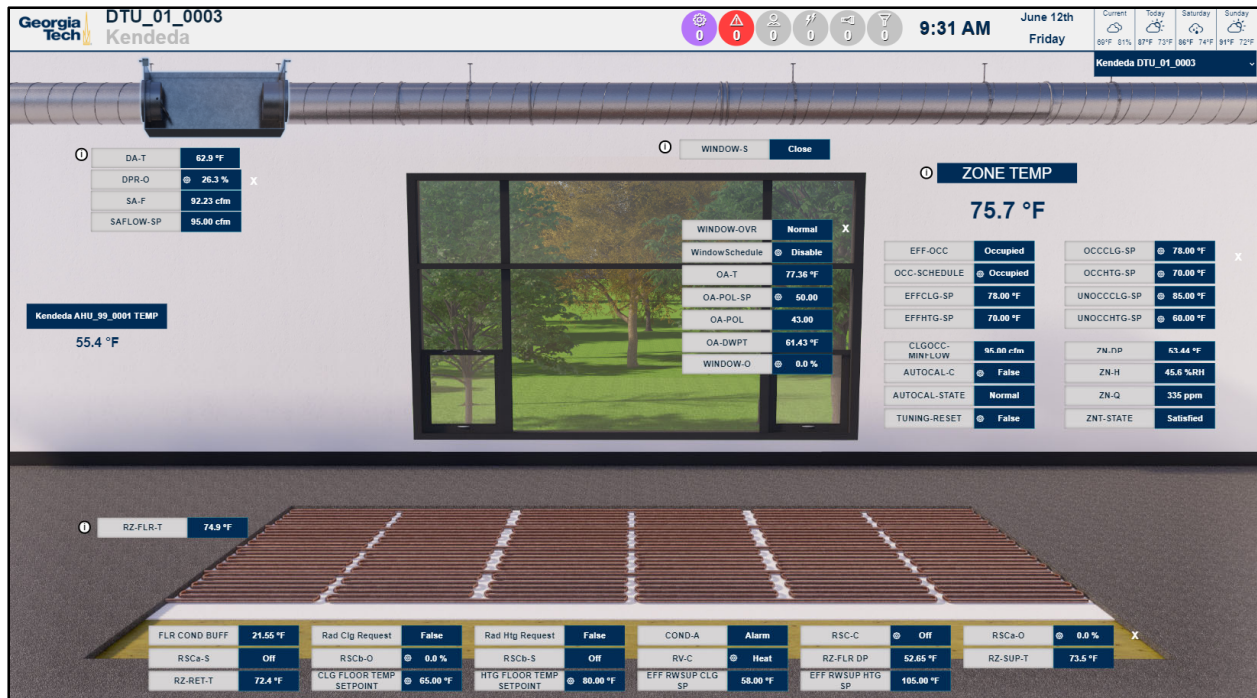
*Terminal Units*

There are 21 variable air volume terminal units in the building that have cooling only and cooling with reheat. The cooling-only terminal units control based on zone CO2 values for demand control. They do not control for space temperature or humidity. The 3 terminal units with reheat serve the restrooms and those reheat valves control for space temperature. The terminal units are integrally linked to the radiant slab manifolds via the BAS.

*Radiant Slab Manifolds*

The Kendeda Building has 17 Radiant Zones designed with radiant slab manifolds and radiant pumping packages to supply cooling and heating to specific locations through a series of in-floor piping. Each zone has slab temperature sensors. These manifolds are the primary heating and cooling for each zone. When the space temperature is between heating and cooling setpoints, the manifold is idle (no heating or cooling within deadband). Below is other pertinent information:

- NOTE: Radiant tubes are cast into the floor throughout the building; do not cut or otherwise puncture the floors without first coordinating with the location of these tubes
- Radiant tubing in slab: 5/8" (PEX Piping)
- Radiant piping supply/return: 1.25"-2.0"
- Space temperature cooling setpoint: 78 F
- Space temperature heating setpoint: 68 F
- Minimum floor temperature setpoint: 65F
- Maximum floor temperature setpoint: 80F
- Radiant floor condensation buffer remain 2 degrees higher than setpoint



View of Typ Zone with Rad Manifold and DCV Terminal Unit

### Operable Windows

Refer to additional info regarding operable windows under the Enclosure section above. Operable windows are controlled by the BAS in normal operation or manual override. Below are scenarios when windows are open:

- Zone temperature exceeds natural ventilation set point and the outside air temperature is less than the zone temperature and pollen count is below threshold
- Manually opened (wall mounted override button)
- Night flush favorable conditions (includes weather forecasting)

Note that radiant flooring pumps shuts off and variable air volume (VAV) damper closes 100% when windows are open. Below are scenarios when windows are closed:

- Outdoor air temperature is greater than indoor temperature
- When outside dew point is greater than the indoor dew point
- Pollen count is above threshold
- Unoccupied mode (time period of 90 minutes)
- Nightly
- Aborting night flush based on 5 different parameters per the design sequence

### Automated Window Shades

There are also automated window shades that interface with the building controls systems. If the radiant floor system is in full cooling mode and the space temperature set point is not satisfied, the

automatic window shades deploy if the outdoor radiation sensor senses above 800 watts per square foot (W/SF).

#### *People Counter System*

People counters are provided at each entry door to tally the number of daily occupants. This information is available on the building FDD dashboard.

#### *Toilet Exhaust System*

The toilet exhaust fan, located on the high roof, operates continuously (24/7/365) and pulls air directly through the composting toilets. The fan speed is set by the fan-mounted variable frequency drive to provide design airflow. This fan is critical to the operation of the composting toilet system. A specialized BAS alarm has been configured to notify Georgia Tech O&M staff whenever the fan has failed.

Each compost bin includes a maintenance booster fan that is intended to operate only when the composting bin is being serviced. Each fan is engaged using a dial timer.

#### *Elevator Room Exhaust Fan*

The fan operates whenever the space temperature exceeds the local thermostat setpoint.

#### *Maker Space Exhaust Fan*

The maker space exhaust fan, located on the high roof, operates based on the maker space occupancy status and the BAS occupancy schedule. The fan operates at minimum speed when the space is unoccupied during normal occupied hours. When occupancy is sensed in the space, the local user on/off switch is enabled. If the switch is depressed then the fan operates at maximum speed.

#### *Fan Coil Units*

Three (3) horizontal fan coil units provide cooling to the MDF and IDF spaces, which are also known as IT closets. These fan coils modulate the chilled water valve to maintain the space temperature. Each fan coil unit has a float switch in the secondary drain pan that shuts off the fan and closes the chilled water coil when triggered.

#### *Air Curtains*

There are air curtains at each building entry point including the green roof. These air curtains operate whenever the associated doors are open (or ajar).

#### *Unit Heaters*

There are two (2) hot water unit heaters in the facility. One is located in and serves the composter room and the other is located in and serves the fire pump room. Each unit heater modulates the heating hot water valve to maintain the space temperature.

#### *Management of O&M Contracts for HVAC system*

- Responsible parties: Area Six Maintenance Manager / Area Maintenance
- Dashboard monitoring: Director/ Area Six Maintenance Manager

## IX. Electrical

### *Components*

The building's electrical components include:

- Luminaires
- Lighting controls
- Occupancy sensors
- Vacancy sensors
- Daylighting sensors
- Ceiling fans

Power distribution components include:

- Metering
- Electrical panels
- Switch gear
- Transformers – Square D TP-1 class 7230, 3-phase pad transformer, 500 kva rated, oil immersed and self-cooled
  - Has a primary voltage of 19,800 V delta and secondary voltage of 208Y/120 with a minimum efficiency rating of (50%LOAD = 99.35%) and a standard of 60 Hertz



- Transformer accessories (for the main exterior pad-mounted transformer which is an oil-based transformer. Interior transformers are dry-type, i.e., no oil)
  - 1' Drain Valve
  - Liquid Level Gauge
  - Pressure Vacuum Gauge
  - Pressure Relief Valve
  - Nitrogen Test Port
- Nitrogen Blanket
- Emergency power off (EPO) switch

*Electricity Budget Management*

- Responsible parties: Director/ Area Six Maintenance Manager
- Dashboard monitoring: Director/ Area Six Maintenance Manager
- Plan for electrical outages, or budget shortages

*Management of O&M Contracts for Electrical Components*

- Responsible parties: Area Six Maintenance Manager / Area Maintenance

**X. Photovoltaic**

The Kendeda Building has a 330 kW (DC) roof mounted photovoltaic (PV) solar array system that consists of approximately 917 solar panels generate over 455,000 kWh per year.

Annual Production			
	Description	Output	% Delta
Irradiance (kWh/m <sup>2</sup> )	Annual Global Horizontal Irradiance	1,652.3	
	POA Irradiance	1,717.1	3.9%
	Shaded Irradiance	1,706.6	-0.6%
	Irradiance after Reflection	1,647.2	-3.5%
	Irradiance after Soiling	1,581.3	-4.0%
	<b>Total Collector Irradiance</b>	<b>1,581.2</b>	<b>0.0%</b>
Energy (kWh)	Nameplate	524,779.5	
	Output at Irradiance Levels	503,625.6	-4.0%
	Output at Cell Temperature Derate	490,757.4	-2.6%
	Output After Mismatch	475,184.0	-3.2%
	Optimal DC Output	474,777.1	-0.1%
	Constrained DC Output	468,027.9	-1.4%
	Inverter Output	456,212.0	-2.5%
	<b>Energy to Grid</b>	<b>442,526.0</b>	<b>-3.0%</b>
Temperature Metrics			
	Avg. Operating Ambient Temp		18.1 °C
	Avg. Operating Cell Temp		26.2 °C
Simulation Metrics			
	Operating Hours		4698
	Solved Hours		4698

*Panels*

SunPower X-Series X22360-COM commercial solar panels with Maxeon Solar Cells designed to convert sunlight into power for 25 years (production will inherently degrade over time). The PV array is mounted using DPW Solar Power Rail system. The mounting rails are aluminum constructed with top-clamping locking bolts that allows for 10 degrees of tilt and integral wiring channels.

Electrical Data

- Nominal power: 360W
- Rated voltage (Vmpp): 59.1
- Rated current (Impp): 6.09A
- Maximum system voltage: 1000 V UL & 1000 V IEC
- Maximum series fuse: 15A



### Mechanical Data

- Operating condition: -40° F to 185° F
- Impact resistance: 1 inch hail at 52MPH
- Tempered glass high transmission
- Max load
  - Wind: 50 psf
  - Snow: 112 psf

### *Inverter*

SMA Sunny Tri-power 30000TL-US inverter rated for 1000 V DC systems. 3-phase inverter suited for decentralized commercial PV systems with pole ground fault protection, integrated AFCI, and 2 MPP trackers. Complies with IEEE 1547 for interconnecting distributed resources with electrical power.

The inverters operating data is as follows:

- Input
  - Maximum array power: 45,000 Wp STC
  - Maximum DC volt: 1000V
  - MPPT volt: 500V - 800V
- Output
  - AC nominal power: 30,000 W
  - Maximum AC power: 30,000VA
  - Output phase: 3 / 3-N-PE, 3-PE
  - Nominal AC voltage: 480/277 V WYE

### *Conversion System*

- Ideal Power Stabiliti-30C Dual Port (AC-DC) 30KW power conversion system
  - AC1 Port – Bidirectional AC
  - Continuous output: 29.99kW
  - Nominal AC current: 37A
  - Nominal output voltage: 480Vac
  - Nominal output frequency: 60Hz
- DC2 Port – Battery
  - Maximum DC power: 30kW
  - Maximum DC current: 60A
  - Operating voltage range: 100Vdc – 1000Vdc
  - GFDI protection: 1A Fused



**View of PV Array BAS Graphic**

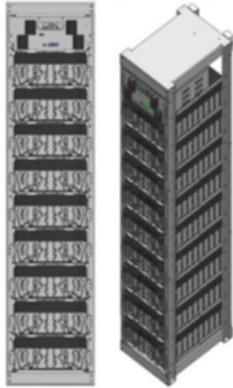
### *Battery System*

The battery tower satisfies the LBC compliance for resiliency. The tower uses Samsung SDI lithium ion battery cells. Sizing is based on 10% of a week's worth of lighting energy consumption, plus refrigeration loads. The lighting energy consumption was derived from the design-phase energy model by taking a year's worth of anticipated lighting energy, dividing by 52 weeks, and multiplying by 0.1; however, it is not dedicated to those components. When building power is down, the battery tower powers the BAS control panels (which can allow windows to open) and the exterior shades with the intent being to keep the building comfortable during a lapse in utility power.

### Specifications

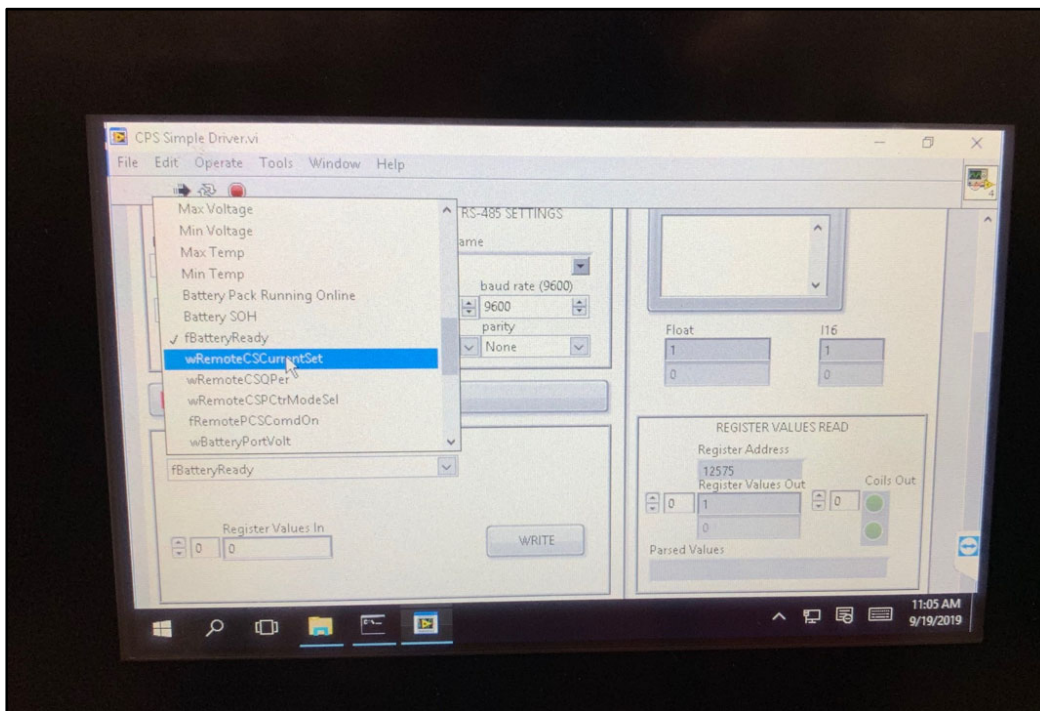
- Battery cell specification
  - Chemistry - Nickel Cobalt Manganese (NCM)
  - Nominal Capacity 94ah
  - Nominal Voltage 3.68
  - Operating Voltage 3.2 - 4.5
  - Overcharge Safety Device (OSD) prevents overcurrent flow
- Battery Module
  - Samsung SDI energy storage system is a rack mounted module assembly configured using 22 NCM cells in series.
  - The battery management system is a rack-level assembly that measures voltage and current.

- Module Rack Frame

Rack	Parameters	Specification
	Configuration	198S 1P
	Key component	9 Modules, 1 Switch Gear
	Dimension (L x W x H)	442 x 702 x 1792 mm
	Weight	~ 590 kg
	Nominal Capacity	94Ah
	Nominal energy	68.49kWh (1/3C Rating)
	Nominal voltage	728.64V
	Operating voltage	633.6V ~ 821.7V
	Power Continuous	34.2 (0.5C rating)
	Frame Material	SGHC (Non coating, HGI)

#### Management of O&M Contracts for Maintenance

- Responsible parties: Area Six Maintenance Manager / Area Maintenance
- Dashboard monitoring: Director/ Area Six Maintenance Manager



**View of Battery Tower Control Screen**

## XI. Plumbing

### *Plumbing Components*

The building's plumbing components include fixtures, domestic hot water, pumps, master mixing valve, backflow preventer, air compressor, trap primers, and piping. Additional details about some of these components are provided below.

#### Domestic Hot Water

- Rheem PROPH65 Hybrid Electric Water Heater
  - Located in the basement mechanical room
  - 75 Gallons first hour delivery
  - 53 G.P.H.
  - Electrical breaker: 15 AMP
  - LCD screen with Wi-Fi connection technology and mobile app. (Rheem.com\hybridsolutions)
  - 10 year warranty



**View of Water Heater Control Panel**

- Point-of-Use Under Cabinet Water Heater
  - Located under the coffee cart sink
  - High efficiency stainless steel heating element
  - Over temperature cutoff protection
  - 120 Volt AC / 2000 watts

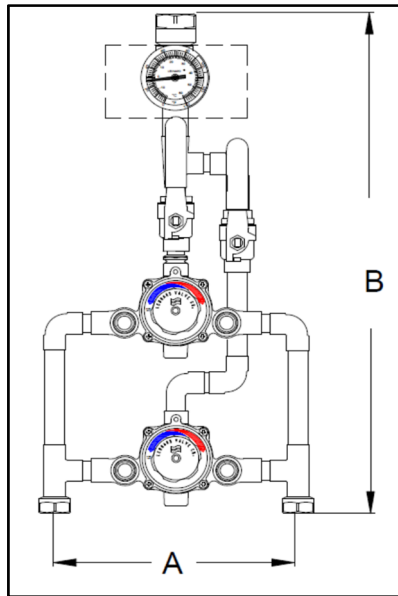
- 6 nominal gallons
- 6 year warranty

### Pumps

- Taco 009-SFS Cartridge recirculating pump (High Head/Low-Flow). The pump is direct drive with replaceable cartridge and stainless steel casing. Single phase 1/8 HP motor rated for 10gpm max.
  - Max head pressure of 35ft, operating at 5gpm at 23 ft head pressure
  - Fluid Temp MIN 40° F and MAX 230° F

### Master Mixing Valve

- Leonard TM-420B-LF-DT-RF Mixing Valve
  - Adjustable high limit stop set for 120° F



**View of TMV Temp Gauge**

### Trap Primers

- Automatic mini trap primers with primer lines are routed downward with gravity slope towards floor drains

### Piping

- Underground – Type K Copper, Hub & Spigot Cast Iron, HDPE
- Above Ground – Type L Copper Pro-press, DWV Copper, ABS Schedule 40, Schedule 40 304SS, No-HUB Cast Iron, Schedule 40 Black Steel, Schedule 40 Threaded Black Steel

### *Plumbing Systems*

Plumbing system will be metered for reuse rainwater (WM101), Greywater Influent (WM-103) and Municipal usage (WM-101).



### Water Consumption/Collection Management

- Responsible parties – Director/ Area Six Maintenance Manager
- Dashboard Monitoring – Director/ Area Six Maintenance Manager
- Plan for low level water reserves or drought conditions

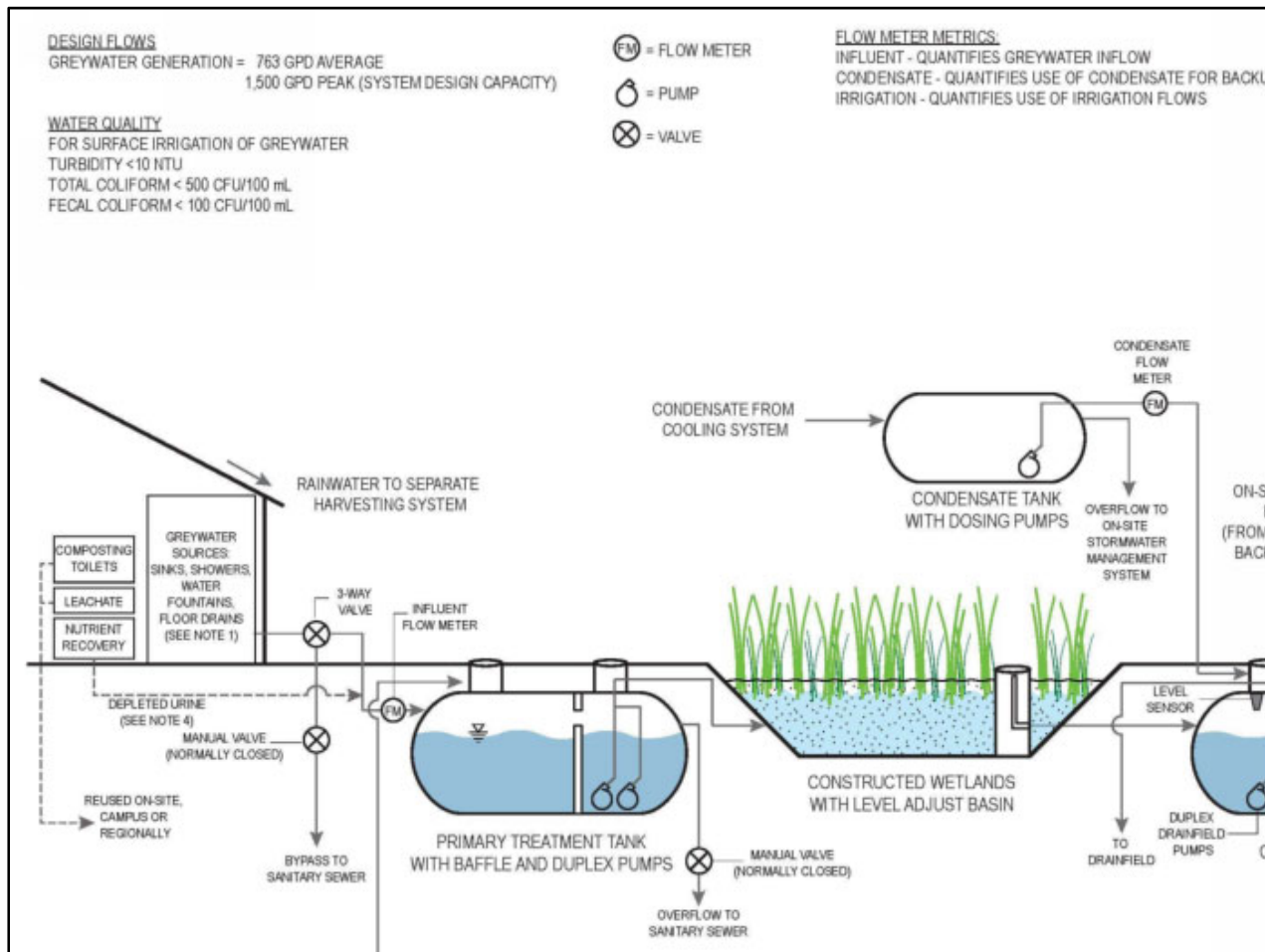
### Water Quality Monitoring

### Management of O&M Contracts for Plumbing Components

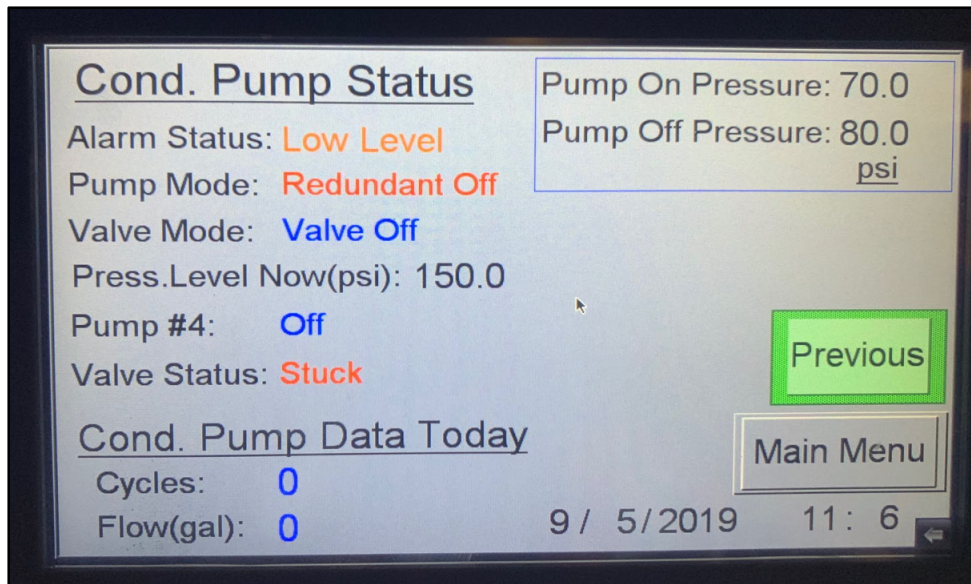
- Responsible parties – Area Six Maintenance Manager / Area Maintenance

## XII. Grey Water

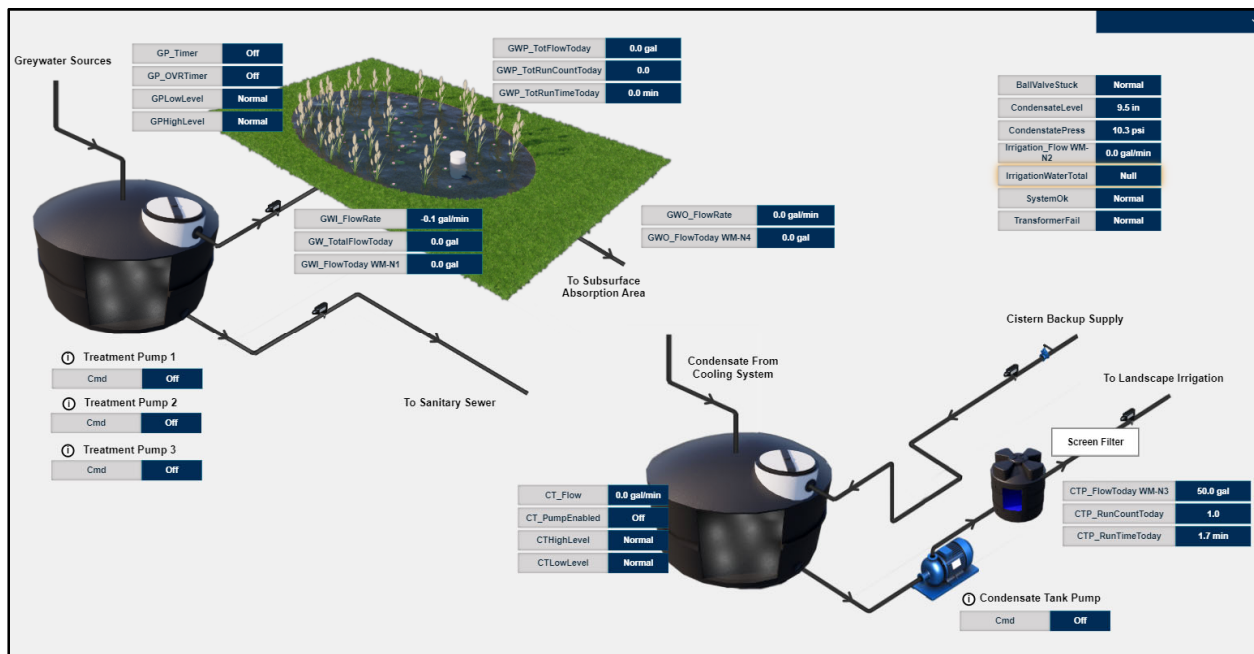
See schematic below for the greywater system. Note that greywater harvested from the building is infiltrated back onto/into the site. It is not reused inside the building. If greywater were to exceed tank capacity, excess greywater would overflow to sewer. The HVAC condensate is collected in a dedicated condensate tank that is used only for irrigation purposes. During times when condensate is low or not produced (cooler months), there is a line from the rainwater cistern to the condensate tank in the event that irrigation is required. Refer to Water Management Work Plan for more detail.



Greywater Schematic



View of Greywater Control Panel Touchscreen



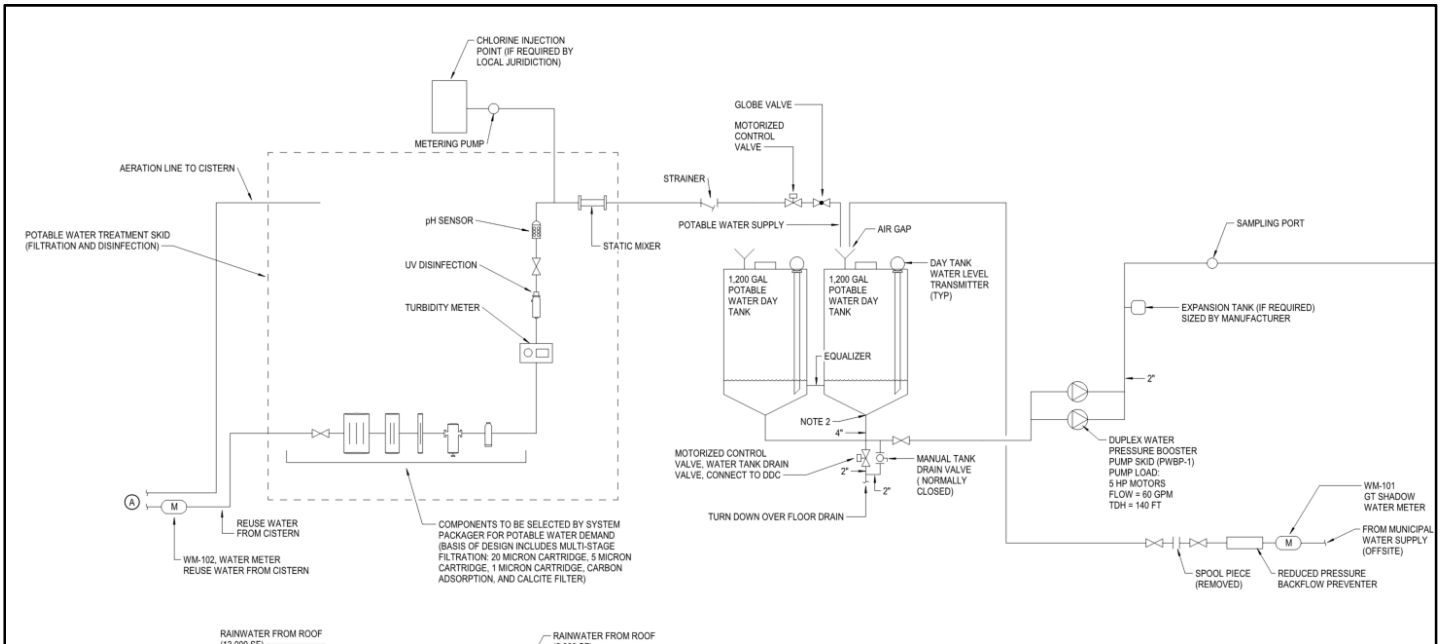
View of Greywater/Condensate BAS Graphic

### XIII. Potable Water

The rainwater harvesting strategy for the building includes capturing water from the rooftop, providing first-flush diversion and inlet filtration, storing it in a cistern, filtering and disinfecting it, and day tanks with booster pumps to provide a pressurized supply of potable water to the building. The potable water system will also include a supply to the irrigation system that can be used on an as-needed basis so long as adequate water is available within the cistern. A backup/emergency connection to the municipal water supply will be installed but not used (manual shut-off valve or capped line). Overflow from the



cistern will go to the onsite stormwater management system (West elevation). Refer to Water Management Work Plan for more detail.

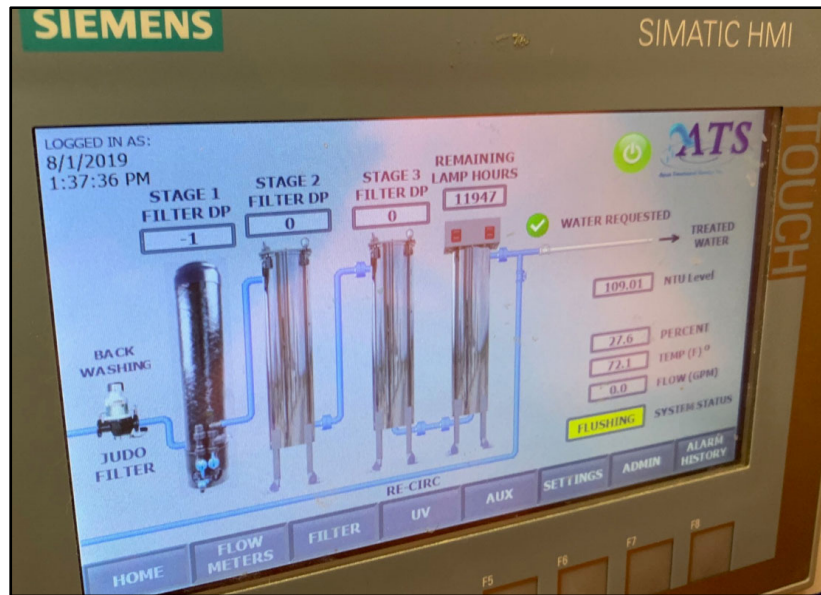


**Rainwater/Potable Water Schematic**

Transfer skid is a Prodigy variable speed booster pump system designed for high flow applications. The pumps comply with ASHRAE 90.1 with pressure control software for auto tuning, stainless steel headers, and end suction pumps for ease of service and maintenance. The treatment skid is a multi-stage filtration skid (see schematic above). See photo of filters below (including final UV filter system).



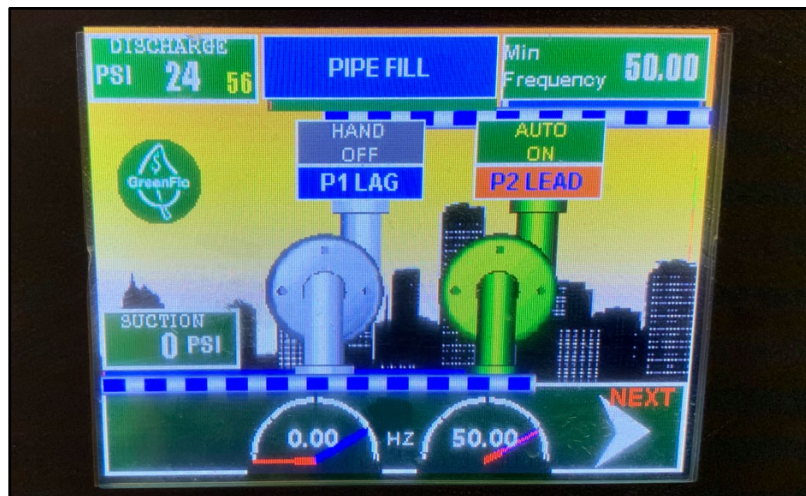
**Potable Water Filtration Skid**



**View of Treatment Skid Control Panel Touchscreen**

Treated (potable) water is transferred to two (2) day tanks due to the physical size of the tanks compared to design volume. These tanks are not pressurized (atmospheric) and hold water for up to 5 days of average daily potable use. There is an isolation valve in the equalizing line as well which allows the tanks to separately hold treated water and city water separately as a back-up, if needed.

Building pumps consist of traditional domestic water duplex booster pump skid with on-board smart control panel (controlling to system pressure setpoint).



**Building Potable Booster Pump Control Screen**

Meters are Seametrics WMP104 Plastic-Body Magmeter, which has a polypropylene flow tube that permits unobstructed flow minimizing disturbances. Other details are:

- Battery powered (6) AA 1.5V lithium cell (1 year)
- Operating pressure: 150psi

- Operating temperature: 10° to 130° F
- Flow range: 14gpm (MIN) to 670gpm (MAX)

#### *Maintenance*

Preventive maintenance (PM) will be scheduled by the Area Six Maintenance Manager and conducted daily by the Area Maintenance technician. The PM will include conducting checks and maintenance tasks on all mechanical components and building automation systems and controls.

#### *Management of O&M Contracts for Water Quality/Testing*

- See Water Management Work Plan for more details
- Responsible parties – Area Six Maintenance Manager / Area Maintenance
- Dashboard monitoring – Director/ Area Six Maintenance Manager

### **XIV. Composting Units / Leachate**

The building uses the Clivus Multum M35 composting toilet system, which is an automatic control device that monitors compost mass moistening, utilizing an enclosed factory pre-set timer. Clivus Model 35 Automatic is certified under the NSF 41 standard. The liquid separation tank is a molded from a high density polyethylene resin.

#### *Composter Specifications*

- Storage capacity: 1,747 gal / 234 cf
- Weight: 800 lbs
- Annual capacity: 65,000 visits
- In-line fan direct drive: 263cfm / 120v AC
- Tank alarm accounts for liquid level and air flow
- Submersible liquid removal rump

#### *Liquid Separation Tanks (Leachate Tanks)*

- Two (2) 1,000-gallon Rotoplas
- Stores liquid separately from compost

#### *Foam Flush Toilet*

- Foam flush from front and back of unit using 4oz of water
- Piping to composter downward slope of 45 degrees or steeper
- Height: 16in
- Power: 110v AC
- Tank capacity: 9.4 qt
- Flush timer: 45 seconds
- Toilet serves as exhaust system intake point for odor control



**Kendeda Building Composting Toilet**

- Neponol soap requirement (biodegradable mild soap)

*Gerber 27-740 Urinal*

- Wall hung, waterless urinal
- 3/4" inlet
- 1 1/2" outlet

*Management of O&M Contracts for Composting Units and Leachate Storage*

- Responsible parties – Area Six Maintenance Manager / Area Maintenance

**XV. Intelligent Building Systems**

*Building Automation Systems*

- Johnson Controls Metasys platform, accessible with appropriate Georgia Tech credentials for VPN access and Metasys account
- Main controllers: NCE-373 and NAE-374
- Control of all HVAC systems
- Scope included provisions of a Yakagowa Datalogger (integration of building energy meters)

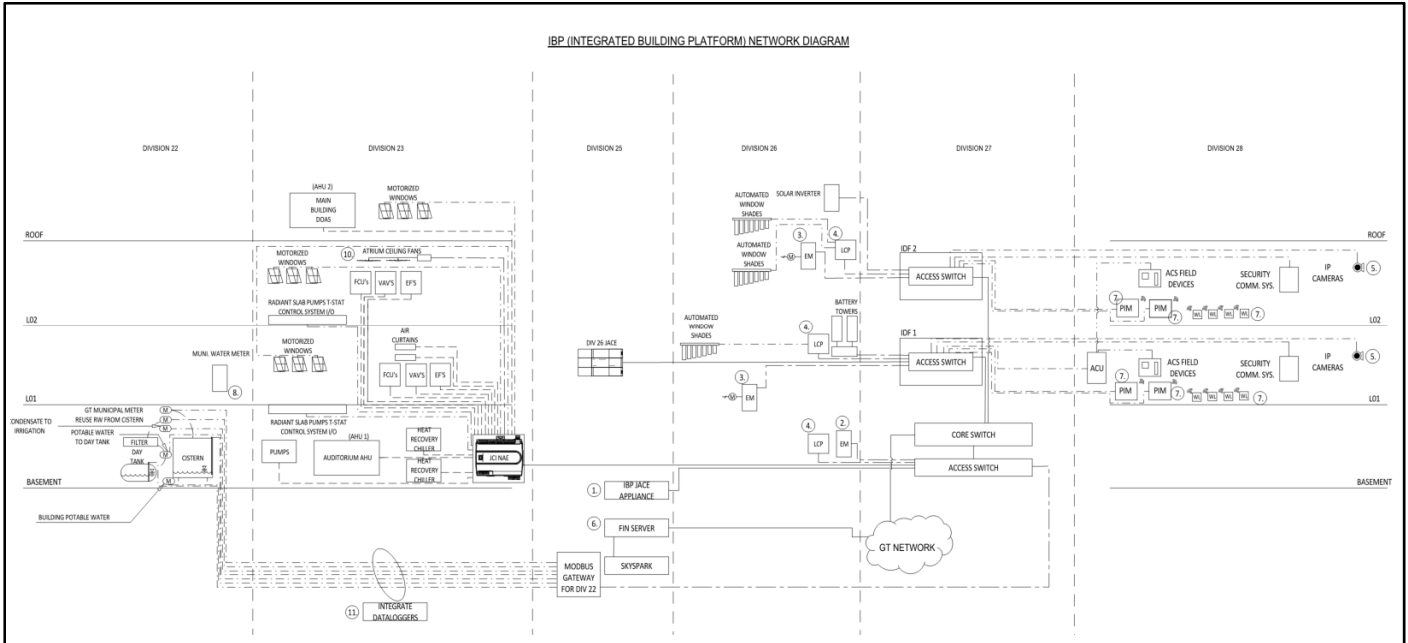
*Graphics, Fault Detection, Trending*

EntroCIM system provided by Hepta Systems (Skyspark platform). EntroCIM integrates all building controls systems into a single platform for viewing and interaction (though very limited control). This platform is the primary front end for reviewing, troubleshooting, and monitoring building performance for “back-of-house” members of the Georgia Tech team. This specifically falls to the Area Six



Maintenance Manager after project warranty expiration. During the LBC Performance Period, numerous design and construction team engineers will be actively monitoring EntroCIM.

In addition to typical alarms and graphics normally found in a BAS, the Intelligent Building (IB) platform also includes “smart” fault detection and diagnostics to assist the O&M team with troubleshooting, particularly with respect to energy use. To that end, the building energy modeling data is available through the platform as a baseline to review building performance.



Integrated Building Systems Platform Diagram

The screenshot displays the EntroCIM Keneda Bldg Dashboard/Main Page. At the top, it shows the building name 'Keneda', area '37000ft²', and current time '1:19 PM' on 'June 12th Friday'. A status bar indicates '35kW' and various alarm icons. Below the header is a 3D architectural rendering of the building. A table in the top left corner provides a summary of system status across different levels:

Name	Alarms	Control Faults	Plant Faults	Energy Faults	Misc. Faults
Basement	2	0	0	0	0
Floor 1	0	0	0	0	0
Floor 2	0	0	0	0	0
Roof	0	0	0	0	0

Several data cards are visible:
 

- AHU BL 0001:** UnOccupied, ZN Temp 77.7 °F, DA Temp 75.4 °F.
- AHU 99 0001:** Occupied, ZN Temp 78.4 °F, DA Temp 55.7 °F.
- Plant:** Null, HRC 1 Disable (HWRT 75.43 °F, HWST 75.67 °F), HRC 2 Disable (CHWRT 45.0 °F, CHWST 41.5 °F).
- Main Meter:** ENERGY DELIVERED 84560.0 kWh, ENERGY RECEIVED 283063.0 kWh.
- Composter Exhaust:** Alarm Normal.
- One-Line Diagrams:** Electrical and Water.

EntroCIM Keneda Bldg Dashboard/Main Page

### *CMMS Integration*

- AiM by AssetWorks for work desk PC
  - Work order management
  - Asset management
  - Preventive maintenance
  - Inventory control
- Go Operation & Maintenance by AssetWorks for mobile devices
  - Daily assignments
  - Time management
  - Purchase request and shop stock
  - Customer request

## **XVI. Schedules, Staffing, Emergency Response**

### *Schedules*

Schedules will be determined by code, manufacturers' recommendation, and industry best practices. Schedules can be altered due to baseline performance targets, metered data, and weather patterns.

### *Staffing*

Designated Area Six staff have primary responsibility and rely on other Area's staff for assistance (e.g., Area Two personnel assist with plumbing). Third party contractors that are responsible for building systems include:

- Johnson Controls – building automation
- SkySpark (Hepta Systems) – fault detection
- Thyssenkrupp - elevator
- Clivus Multrum – composting toilet system
- Rooter Plus – leachate removal
- Marcus Thomas – potable water system

### *Emergency Response*

- During normal business hours handled by Area Six Maintenance Manager
- After hours will require notification to Campus Police to dispatch On Call technician and On-Call Manager/Supervisor

## **XVII. Materials, Events, Vendors**

### *Materials*

All Materials used will be compliant with the LBC Standard. For more information, refer to the Materials Management Work Plan: <http://livingbuilding.gatech.edu/manual/materials-management>. All materials used for maintenance will be submitted to the Areas Six Maintenance Manager for approval prior to use or installation.

No mechanical, electrical, and plumbing (MEP) attic stock provided as part of the Construction Manager (CM) Agreement. Several MEP components warrant consideration for purchase by Georgia Tech O&M to have readily available in the event of equipment failures particularly given the long lead times for many of the specialty components within the MEP systems. Not in maintenance stock as of June 2020, but worth considering:

- Composter exhaust fan motor
- Radiant manifold pump kit/assembly
- Operable window control actuator

#### *Events*

All after hour and weekend events will be coordinated with the designated staff.

#### *Vendors*

The Area Six Maintenance Manager will manage visits from all external maintenance vendors, suppliers, and material trades. Vendors that have a service agreement with Georgia Tech have been notified that they have to obtain approval from the Area Six Maintenance Manager prior to entering The Kendeda Building site.

### **XVIII.Related Work Plans**

- a. Water Management: <http://livingbuilding.gatech.edu/manual/water-management>
- b. Landscape Operations and Maintenance Work Plan: <http://livingbuilding.gatech.edu/manual/landscape-management>
- c. Materials Management Work Plan: <http://livingbuilding.gatech.edu/manual/materials-management>

### **XIX.Revision History**

- a. Revision 0: September 13, 2018 (led by Georgia Tech O&M)
- b. Revision 1: June 12, 2020 (updates by Epsten Group)
- c. Revision 2: July 22, 2020 (updates by Georgia Tech – Shan Arora)
- d. Revision 3: August 4, 2020 (updates by Epsten Group)
- e. Revision 4: August 5, 2020 (updates by Georgia Tech – Shan Arora)