Layout of computer room:

Computer Room Layout - 7/8/2016

	Row	6	
	Pod	A	
R6-PA-C02	2	1	R6-PA-C01
R6-PA-C04	4	3	R6-PA-C03
R6-PA-C06	6	5	R6-PA-C05
R6-PA-C08	8	7	R6-PA-C07
R6-PA-C10	10	9	R6-PA-C09
R6-PA-C12	12	11	R6-PA-C11
R6-PA-C14	14	13	R6-PA-C13
R6-PA-C16	16	15	R6-PA-C15
R6-PA-C18	18	17	R6-PA-C17
R6-PA-C20	20	19	R6-PA-C19
R6-PA-C22	22	21	R6-PA-C21
R6-PA-C24	24	23	R6-PA-C23
R6-PA-C26	26	25	R6-PA-C25
R6-PA-C28	28	27	R6-PA-C27

	Row	5	
	Pod	A	
R5-PA-C02	2	1	R5-PA-C01
R5-PA-C04	4	3	R5-PA-C03
R5-PA-C06	6	5	R5-PA-C05
R5-PA-C08	8	7	R5-PA-C07
R5-PA-C10	10	9	R5-PA-C09
R5-PA-C12	12	11	R5-PA-C11
R5-PA-C14	14	13	R5-PA-C13
R5-PA-C16	16	15	R5-PA-C15
R5-PA-C18	18	17	R5-PA-C17
R5-PA-C20	20	19	R5-PA-C19
R5-PA-C22	22	21	R5-PA-C21
R5-PA-C24	24	23	R5-PA-C23

	Row	4	
	Pod	A	
R4-PA-C02	2	1	R4-PA-C01
R4-PA-C04	4	3	R4-PA-C03
R4-PA-C06	6	5	R4-PA-C05
R4-PA-C08	8	7	R4-PA-C07
R4-PA-C10	10	9	R4-PA-C09
R4-PA-C12	12	11	R4-PA-C11
R4-PA-C14	14	13	R4-PA-C13
R4-PA-C16	16	15	R4-PA-C15
R4-PA-C18	18	17	R4-PA-C17
R4-PA-C20	20	19	R4-PA-C19
R4-PA-C22	22	21	R4-PA-C21
R4-PA-C24	24	23	R4-PA-C23

	Row	3	
	Pod	A	
R3-PA-C02	2	1	R3-PA-C01
R3-PA-C04	4	3	R3-PA-C03
R3-PA-C06	6	5	R3-PA-C05
R3-PA-C08	8	7	R3-PA-C07
R3-PA-C10	10	9	R3-PA-C09
R3-PA-C12	12	11	R3-PA-C11
R3-PA-C14	14	13	R3-PA-C13
R3-PA-C16	16	15	R3-PA-C15
R3-PA-C18	18	17	R3-PA-C17
R3-PA-C20	20	19	R3-PA-C19
R3-PA-C22	22	21	R3-PA-C21
R3-PA-C24	24	23	R3-PA-C23

	Row	2	
	Pod	A	
R2-PA-C02	2	1	R2-PA-C01
R2-PA-C04	4	3	R2-PA-C03
R2-PA-C06	6	5	R2-PA-C05
R2-PA-C08	8	7	R2-PA-C07
R2-PA-C10	10	9	R2-PA-C09
R2-PA-C12	12	11	R2-PA-C11
R2-PA-C14	14	13	R2-PA-C13
R2-PA-C16	16	15	R2-PA-C15
R2-PA-C18	18	17	R2-PA-C17
R2-PA-C20	20	19	R2-PA-C19
R2-PA-C22	22	21	R2-PA-C21
R2-PA-C24	24	23	R2-PA-C23

	Row	1	
	Pod	A	
R1-PA-C02	2	1	R1-PA-C01
R1-PA-C04	4	3	R1-PA-C03
R1-PA-C06	6	5	R1-PA-C05
R1-PA-C08	8	7	R1-PA-C07
R1-PA-C10	10	9	R1-PA-C09
R1-PA-C12	12	11	R1-PA-C11
R1-PA-C14	14	13	R1-PA-C13
R1-PA-C16	16	15	R1-PA-C15
R1-PA-C18	18	17	R1-PA-C17
R1-PA-C20	20	19	R1-PA-C19
R1-PA-C22	22	21	R1-PA-C21
R1-PA-C24	24	23	R1-PA-C23

	Row	6	
	Pod	B	
R6-PB-C02	2	1	R6-PB-C01
R6-PB-C04	4	3	R6-PB-C03
R6-PB-C06	6	5	R6-PB-C05
R6-PB-C08	8	7	R6-PB-C07
R6-PB-C10	10	9	R6-PB-C09
R6-PB-C12	12	11	R6-PB-C11
R6-PB-C14	14	13	R6-PB-C13
R6-PB-C16	16	15	R6-PB-C15
R6-PB-C18	18	17	R6-PB-C17
R6-PB-C20	20	19	R6-PB-C19
R6-PB-C22	22	21	R6-PB-C21

	Row	5	
	Pod	B	
R5-PB-C02	2	1	R5-PB-C01
R5-PB-C04	4	3	R5-PB-C03
R5-PB-C06	6	5	R5-PB-C05
R5-PB-C08	8	7	R5-PB-C07
R5-PB-C10	10	9	R5-PB-C09
R5-PB-C12	12	11	R5-PB-C11
R5-PB-C14	14	13	R5-PB-C13
R5-PB-C16	16	15	R5-PB-C15
R5-PB-C18	18	17	R5-PB-C17
R5-PB-C20	20	19	R5-PB-C19

	Row	4	
	Pod	B	
R4-PB-C02	2	1	R4-PB-C01
R4-PB-C04	4	3	R4-PB-C03
R4-PB-C06	6	5	R4-PB-C05
R4-PB-C08	8	7	R4-PB-C07
R4-PB-C10	10	9	R4-PB-C09
R4-PB-C12	12	11	R4-PB-C11
R4-PB-C14	14	13	R4-PB-C13
R4-PB-C16	16	15	R4-PB-C15
R4-PB-C18	18	17	R4-PB-C17
R4-PB-C20	20	19	R4-PB-C19

	Row	3	
	Pod	B	
R3-PB-C02	2	1	R3-PB-C01
R3-PB-C04	4	3	R3-PB-C03
R3-PB-C06	6	5	R3-PB-C05
R3-PB-C08	8	7	R3-PB-C07
R3-PB-C10	10	9	R3-PB-C09
R3-PB-C12	12	11	R3-PB-C11
R3-PB-C14	14	13	R3-PB-C13
R3-PB-C16	16	15	R3-PB-C15
R3-PB-C18	18	17	R3-PB-C17
R3-PB-C20	20	19	R3-PB-C19

	Row	2	
	Pod	B	
R2-PB-C02	2	1	R2-PB-C01
R2-PB-C04	4	3	R2-PB-C03
R2-PB-C06	6	5	R2-PB-C05
R2-PB-C08	8	7	R2-PB-C07
R2-PB-C10	10	9	R2-PB-C09
R2-PB-C12	12	11	R2-PB-C11
R2-PB-C14	14	13	R2-PB-C13
R2-PB-C16	16	15	R2-PB-C15
R2-PB-C18	18	17	R2-PB-C17
R2-PB-C20	20	19	R2-PB-C19

	Row	1	
	Pod	B	
R1-PB-C02	2	1	R1-PB-C01
R1-PB-C04	4	3	R1-PB-C03
R1-PB-C06	6	5	R1-PB-C05
R1-PB-C08	8	7	R1-PB-C07
R1-PB-C10	10	9	R1-PB-C09
R1-PB-C12	12	11	R1-PB-C11
R1-PB-C14	14	13	R1-PB-C13
R1-PB-C16	16	15	R1-PB-C15
R1-PB-C18	18	17	R1-PB-C17
R1-PB-C20	20	19	R1-PB-C19

	Row	8	
	Pod	C	
R8-PC-C02	2	1	R8-PC-C01
R8-PC-C04	4	3	R8-PC-C03
R8-PC-C06	6	5	R8-PC-C05
R8-PC-C08	8	7	R8-PC-C07
R8-PC-C10	10	9	R8-PC-C09
R8-PC-C12	12	11	R8-PC-C11
R8-PC-C14	14	13	R8-PC-C13
R8-PC-C16	16	15	R8-PC-C15
R8-PC-C18	18	17	R8-PC-C17
R8-PC-C20	20	19	R8-PC-C19
R8-PC-C22	22	21	R8-PC-C21
R8-PC-C24	24	23	R8-PC-C23

	Row	7	
	Pod	C	
R7-PC-C02	2	1	R7-PC-C01
R7-PC-C04	4	3	R7-PC-C03
R7-PC-C06	6	5	R7-PC-C05
R7-PC-C08	8	7	R7-PC-C07
R7-PC-C10	10	9	R7-PC-C09
R7-PC-C12	12	11	R7-PC-C11
R7-PC-C14	14	13	R7-PC-C13
R7-PC-C16	16	15	R7-PC-C15
R7-PC-C18	18	17	R7-PC-C17
R7-PC-C20	20	19	R7-PC-C19
R7-PC-C22	22	21	R7-PC-C21
R7-PC-C24	24	23	R7-PC-C23

	Row	6	
	Pod	C	
R6-PC-C02	2	1	R6-PC-C01
R6-PC-C04	4	3	R6-PC-C03
R6-PC-C06	6	5	R6-PC-C05
R6-PC-C08	8	7	R6-PC-C07
R6-PC-C10	10	9	R6-PC-C09
R6-PC-C12	12	11	R6-PC-C11
R6-PC-C14	14	13	R6-PC-C13
R6-PC-C16	16	15	R6-PC-C15
R6-PC-C18	18	17	R6-PC-C17
R6-PC-C20	20	19	R6-PC-C19
R6-PC-C22	22	21	R6-PC-C21
R6-PC-C24	24	23	R6-PC-C23
R6-PC-C26	26	25	R6-PC-C25
R6-PC-C28	28	27	R6-PC-C27

	Row	5	
	Pod	C	
R5-PC-C02	2	1	R5-PC-C01
R5-PC-C04	4	3	R5-PC-C03
R5-PC-C06	6	5	R5-PC-C05
R5-PC-C08	8	7	R5-PC-C07
R5-PC-C10	10	9	R5-PC-C09
R5-PC-C12	12	11	R5-PC-C11
R5-PC-C14	14	13	R5-PC-C13
R5-PC-C16	16	15	R5-PC-C15
R5-PC-C18	18	17	R5-PC-C17
R5-PC-C20	20	19	R5-PC-C19
R5-PC-C22	22	21	R5-PC-C21
R5-PC-C24	24	23	R5-PC-C23

	Row	4	
	Pod	C	
R4-PC-C02	2	1	R4-PC-C01
R4-PC-C04	4	3	R4-PC-C03
R4-PC-C06	6	5	R4-PC-C05
R4-PC-C08	8	7	R4-PC-C07
R4-PC-C10	10	9	R4-PC-C09
R4-PC-C12	12	11	R4-PC-C11
R4-PC-C14	14	13	R4-PC-C13
R4-PC-C16	16	15	R4-PC-C15
R4-PC-C18	18	17	R4-PC-C17
R4-PC-C20	20	19	R4-PC-C19
R4-PC-C22	22	21	R4-PC-C21
R4-PC-C24	24	23	R4-PC-C23

	Row	3	
	Pod	C	
R3-PC-C02	2	1	R3-PC-C01
R3-PC-C04	4	3	R3-PC-C03
R3-PC-C06	6	5	R3-PC-C05
R3-PC-C08	8	7	R3-PC-C07
R3-PC-C10	10	9	R3-PC-C09
R3-PC-C12	12	11	R3-PC-C11
R3-PC-C14	14	13	R3-PC-C13
R3-PC-C16	16	15	R3-PC-C15
R3-PC-C18	18	17	R3-PC-C17
R3-PC-C20	20	19	R3-PC-C19
R3-PC-C22	22	21	R3-PC-C21
R3-PC-C24	24	23	R3-PC-C23

	Row	2	
	Pod	C	
R2-PC-C02	2	1	R2-PC-C01
R2-PC-C04	4	3	R2-PC-C03
R2-PC-C06	6	5	R2-PC-C05
R2-PC-C08	8	7	R2-PC-C07
R2-PC-C10	10	9	R2-PC-C09
R2-PC-C12	12	11	R2-PC-C11
R2-PC-C14	14	13	R2-PC-C13
R2-PC-C16	16	15	R2-PC-C15
R2-PC-C18	18	17	R2-PC-C17
R2-PC-C20	20	19	R2-PC-C19
R2-PC-C22	22	21	R2-PC-C21
R2-PC-C24	24	23	R2-PC-C23

	Row	1	
	Pod	C	
R1-PC-C02	2	1	R1-PC-C01
R1-PC-C04	4	3	R1-PC-C03
R1-PC-C06	6	5	R1-PC-C05
R1-PC-C08	8	7	R1-PC-C07
R1-PC-C10	10	9	R1-PC-C09
R1-PC-C12	12	11	R1-PC-C11
R1-PC-C14	14	13	R1-PC-C13
R1-PC-C16	16	15	R1-PC-C15
R1-PC-C18	18	17	R1-PC-C17
R1-PC-C20	20	19	R1-PC-C19
R1-PC-C22	22	21	R1-PC-C21
R1-PC-C24	24	23	R1-PC-C23

Naming Conventions for the Bus Plugs are"

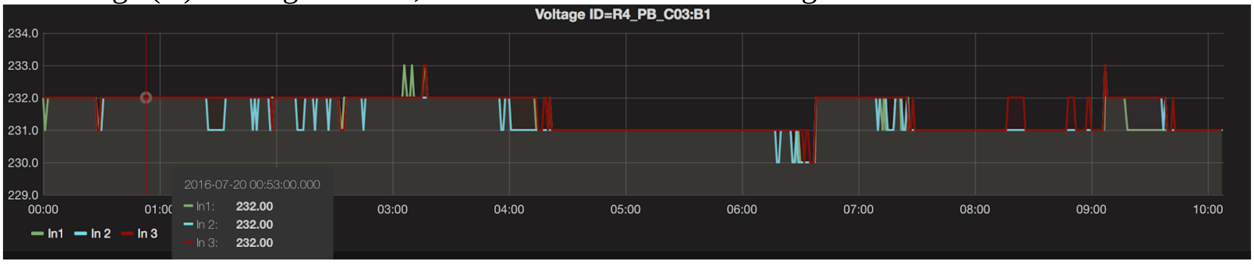
RX_PY_CZZ:KL

Where:
- X is the row that the pod occupies
  - currently between 1 and 8
- Y is a letter designating the position of the pod in the row
  - either A, B, or C
- ZZ is the number of the cabinet within the pod
  - between 1 and 24 for A and C pods, between 1 and 20 for B pods
- K identifies the bus bar that feeds the bus plug. (A or B)
- L identifies the "side" of the pod that the bus plug is on
  - 1 is for bus plugs that feed odd-numbered racks
  - 2 is for bus plugs that feed even-numbered racks
  - L may also have a role in the few cases where there is more than one bus plug per bus bar feeding a single rack. I will defer to Jim on that.

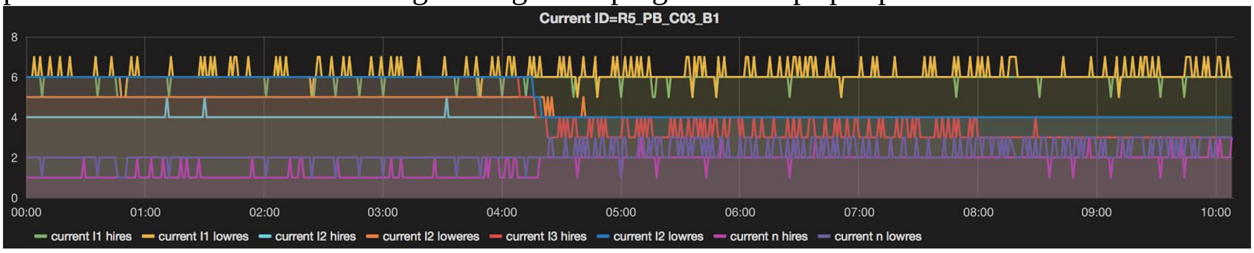
Grafana visualizing collected data: http://129.10.5.134:3000
InfluxDB, time-series DB storing the data: http://129.10.5.134:8083

Dashboard: Electrical Busplug: http://129.10.5.134:3000/dashboard/db/electrical-busplug

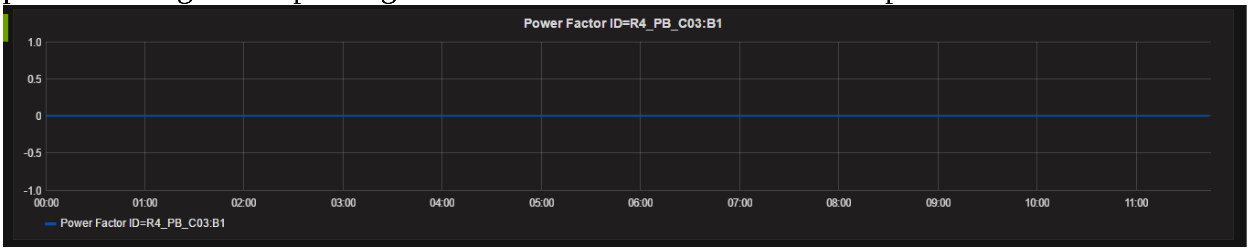
1. Voltage (V): Voltage of LN1,LN2 and LN3. Nominal voltage is around 230 V.



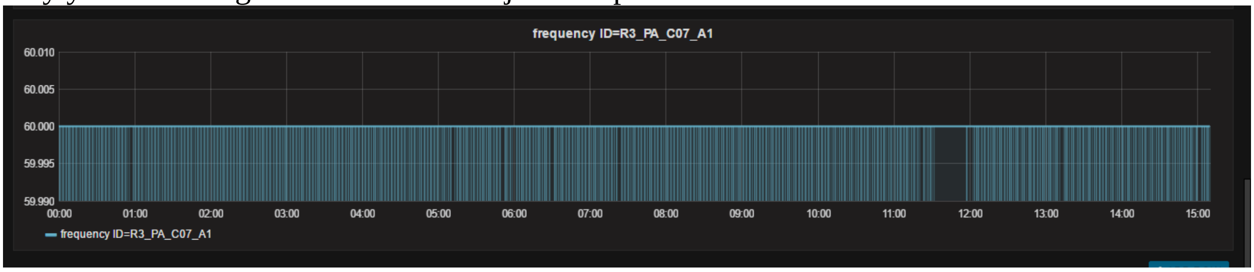
2. Current (A): the lowres and highres refers to low resolution and high resolution respectively (resolutions are 0.1 and 1 for high and low). I1, I2, I3 are the three different phases. Maximum current through a single bus plug is 24 Amps per phase



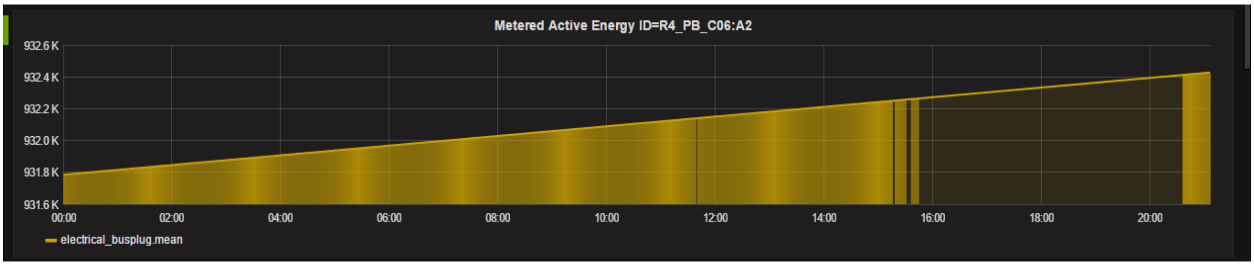
3. Power Factor: The Power Factor is the overall Power Factor. The Power Factor is a ratio value, and therefore has no units. Power Factor is 1.000 when the voltages and currents are in phase with each other, and 0.000 when they are at 90 degrees to each other. may be positive or negative depending on whether the load is inductive or capacitive.



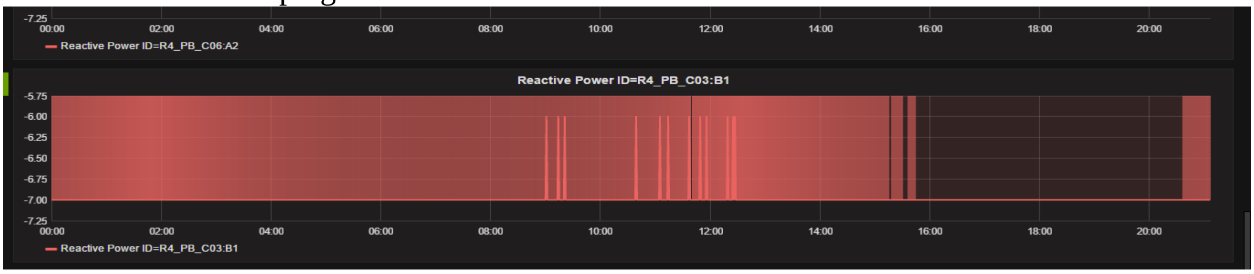
4. Frequency (Hz): Frequency of phase A. The MGHPCC power distribution system distributes three phase power. The phases are labeled "A", "B", and "C". Each phase feeds a subset of the outlets on the power distribution units in a rack. The frequency on all three phases has to be the same (unless something is wrong with the power grid). This might be why you are seeing a measurement for just one phase.



5. Metered active energy (Wh): measures energy used

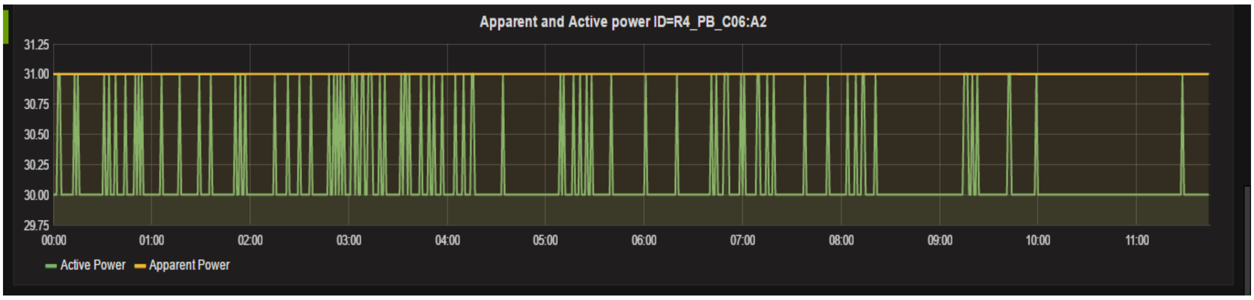


6. Reactive power (VAR): Definition: P = E(rms)*I(rms) where P is the power in watts, E(rms) is the rms voltage in volts, and I(rms) is the rms current in amperes. This value is recorded for each busplug.



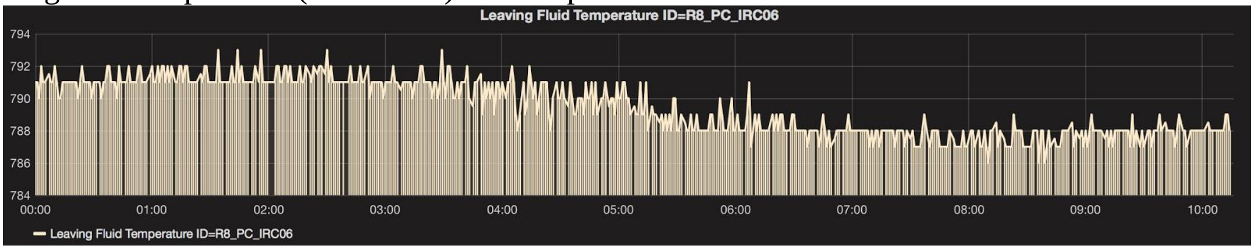
7. Apparent power (VA): the power supplied to a circuit.

8. Active power (W): Def: Power drawn by the electrical resistance of a system doing useful work.

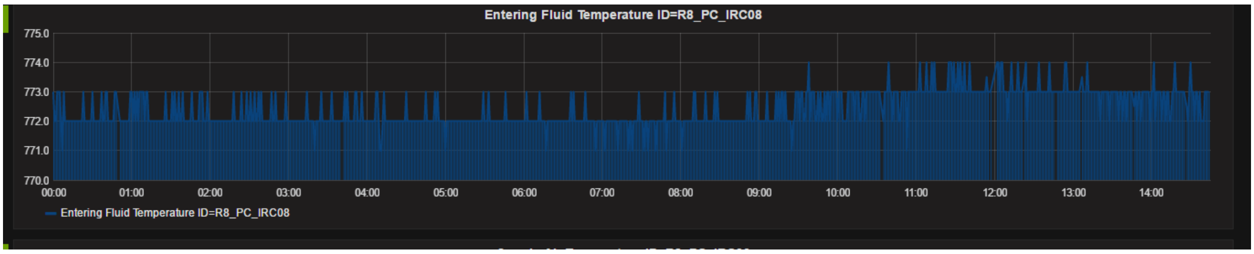


Dashboard: mechanical IRC (everything in this seems to be scaled by 10):
http://129.10.5.134:3000/dashboard/db/mechanical-irc

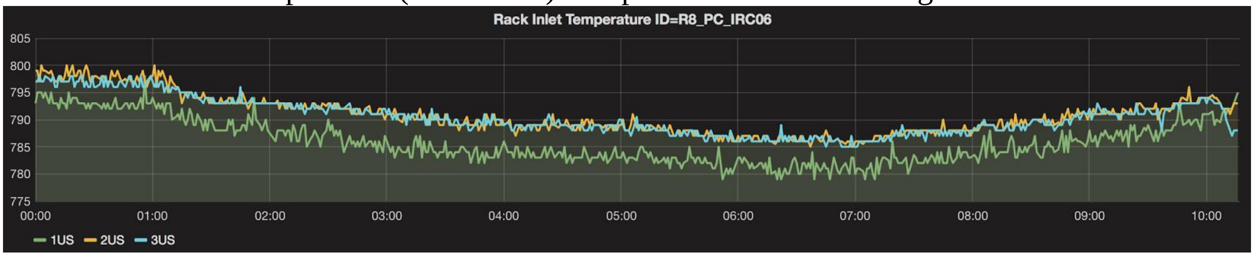
1. Leaving fluid temperature (Fahrenheit): the temperature of the fluid as it leaves the IRCs.



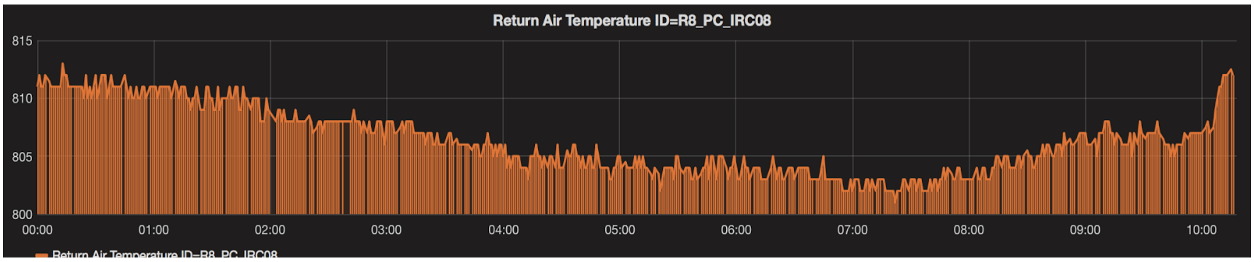
2. Entering fluid temperature (perhaps Fahrenheit): temperature of the fluid as it enters the IRCs.



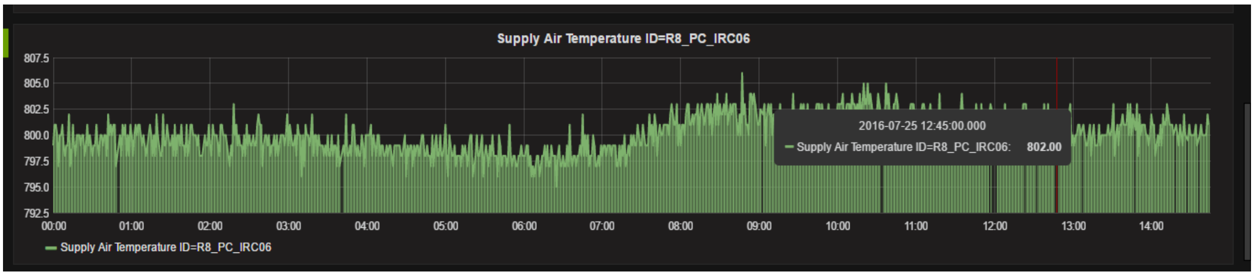
3. Rack inlet temperature (Fahrenheit): temperature of fluid coming into the inlets.



4. Return Air temperature (perhaps Fahrenheit): temperature of the air as it leaves the coolers.

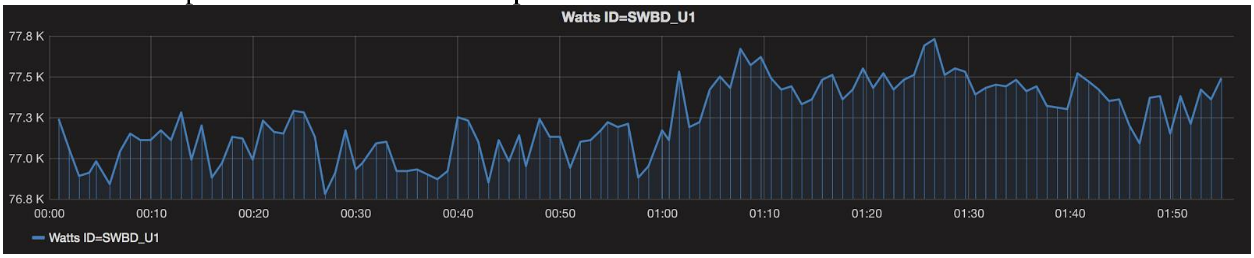


5. Supply air temperature (perhaps Fahrenheit): temperature of the air as it enters the coolers.

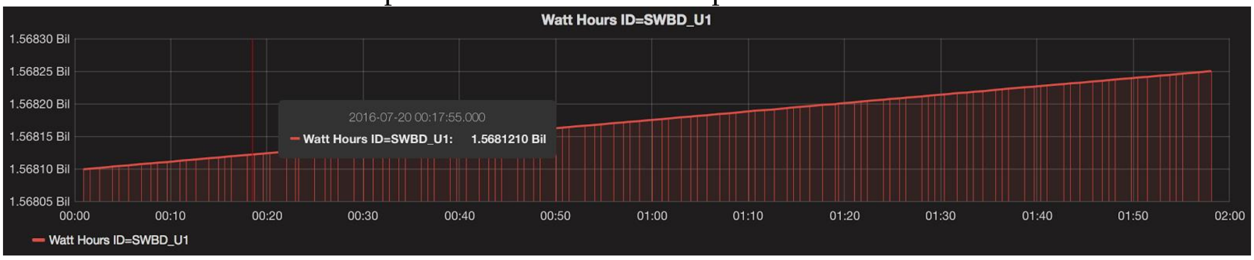


Dashboard: Electrical meters: http://129.10.5.134:3000/dashboard/db/electrical-meters

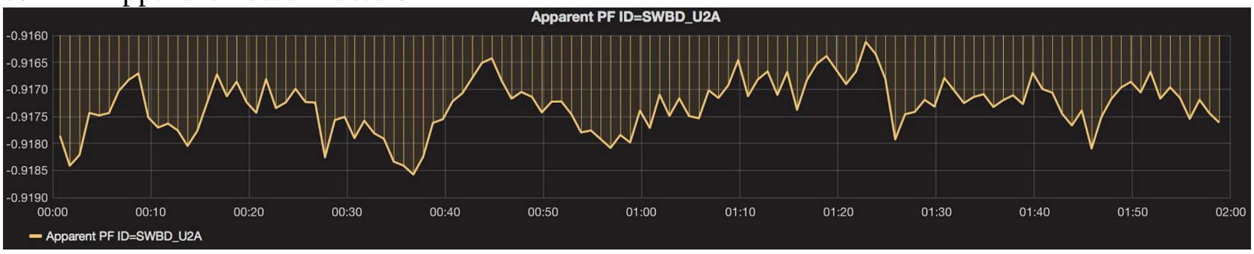
1. Watts: measures power of meter with the specefic ID



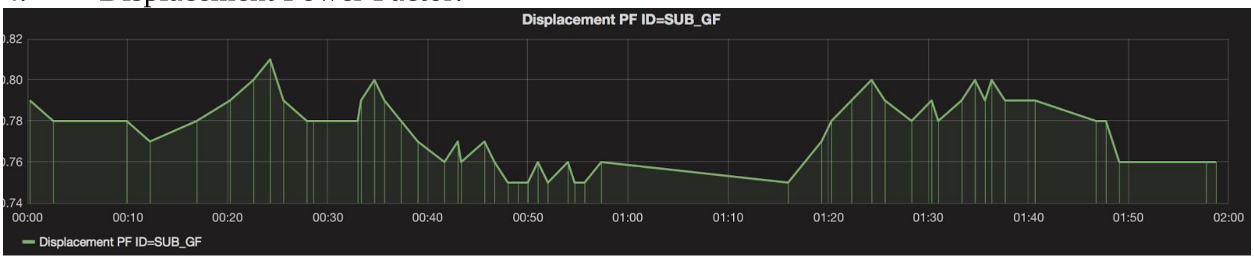
2. Watt hours: measures power of meter with the specefic ID



3. Apparent Power Factor:

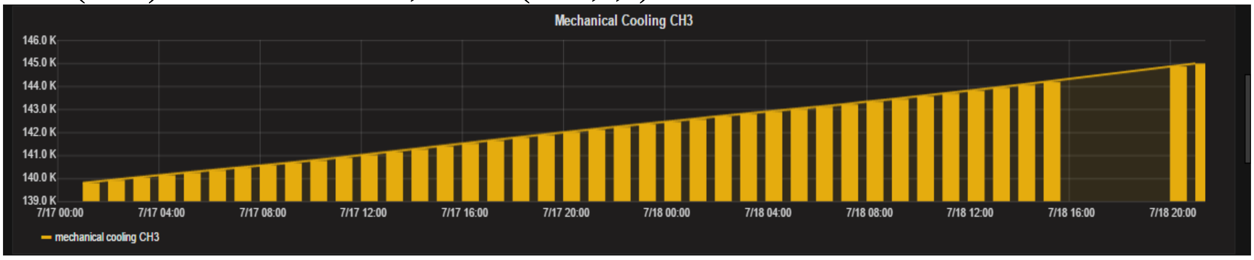


4. Displacement Power Factor:

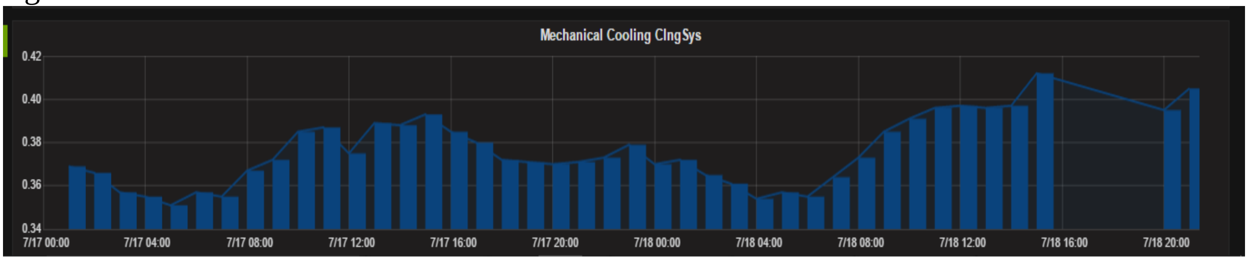


Dashboard: mechanical cooling: http://129.10.5.134:3000/dashboard/db/mechanical-cooling

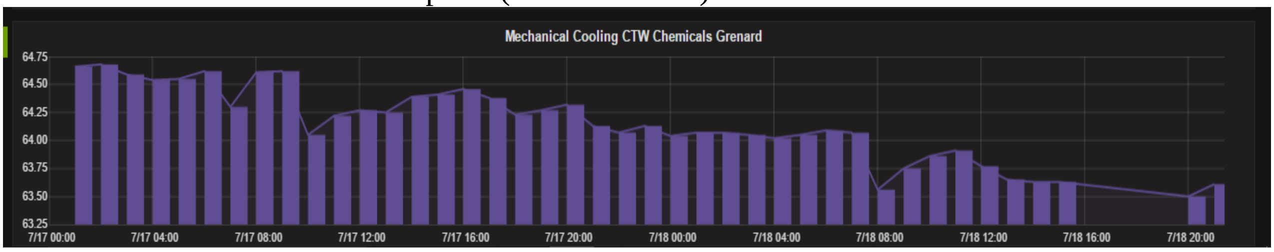
1. Chiller (kWh):Refers to chillers 1,2 and 3 (CH1,2,3).



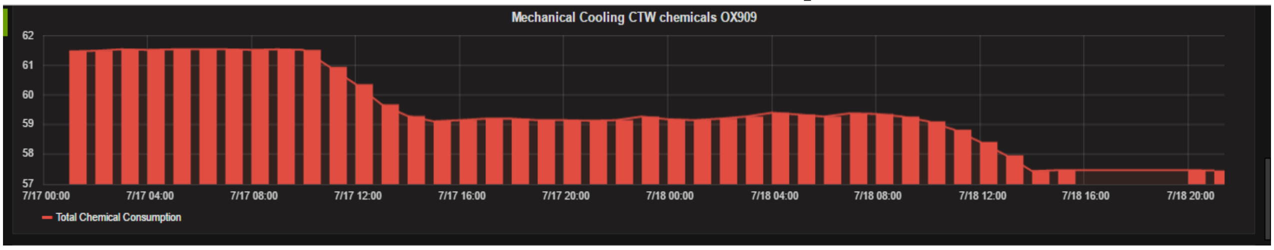
2. ClngSys per hour average (kW per ton): This is the number of kilowatts expended by the cooling plant to remove one ton of refrigeration. a ton of refrigeration is equivalent to 12,000 BTU/h or 3.5 kW. It's actual definition is the heat of fusion absorbed by melting 1 short ton (2,000 lb; 0.893 long tons; 0.907 t) of pure ice at 0 °C (32 °F) in 24 hours. This is a per hour average. don't know what this stands for.



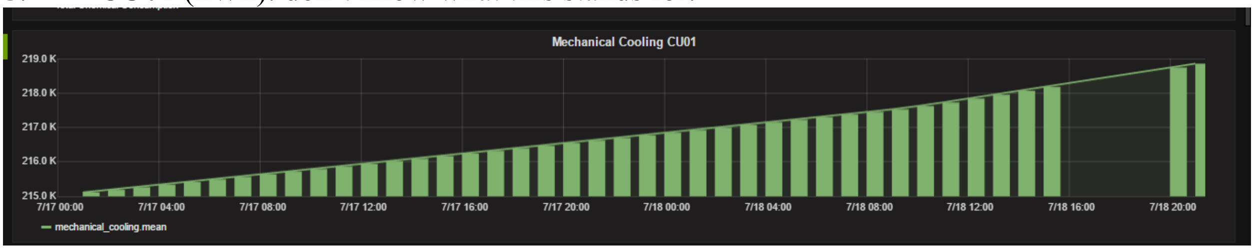
3. CTW Chemicals Grenard: CTW = Cooling Tower Water. don't know what CTW stands for. This measures total chemical consumption (units unknown)



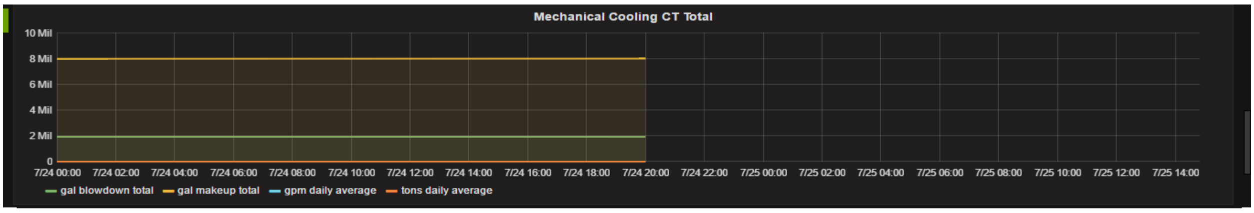
4. CTW chemicals OX909: also measures total chemical consumption. Units unknown



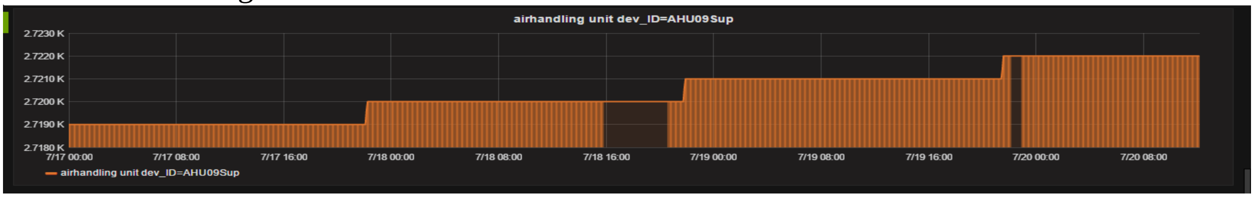
5. CU01 (kWh): don't know what this stands for.



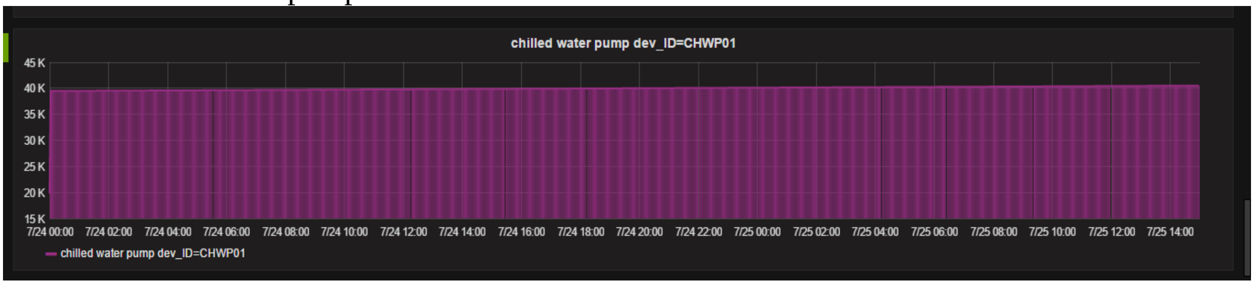
6. CT total: don’t know what CT stands for. Also don’t know what any any of the lines mean.



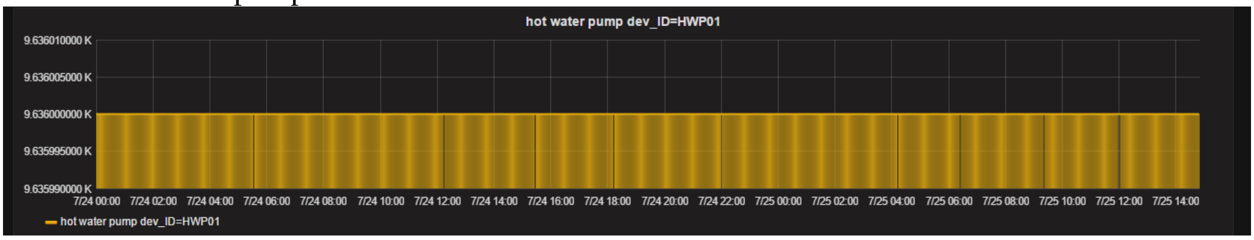
7. Airhandling unit: units unknown



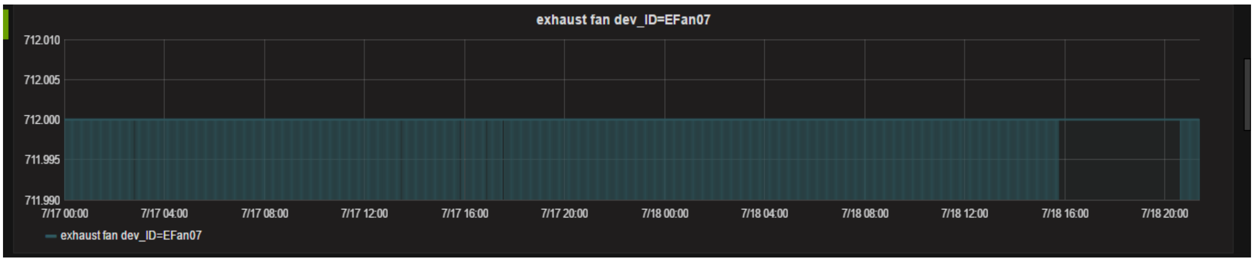
8. Chilled Water pump: units unknown



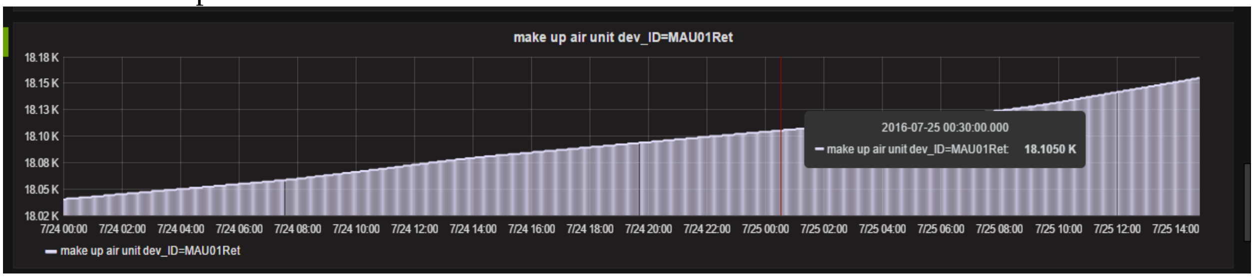
9. Hot water pump: units unknown



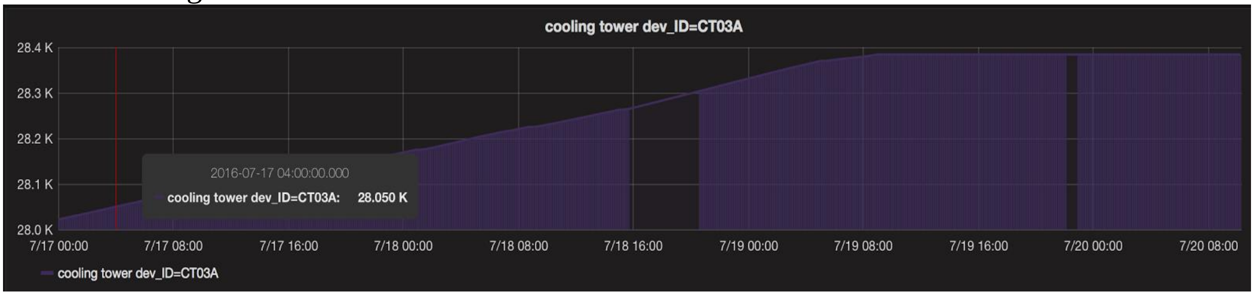
10. Exhaust fan: units unknown



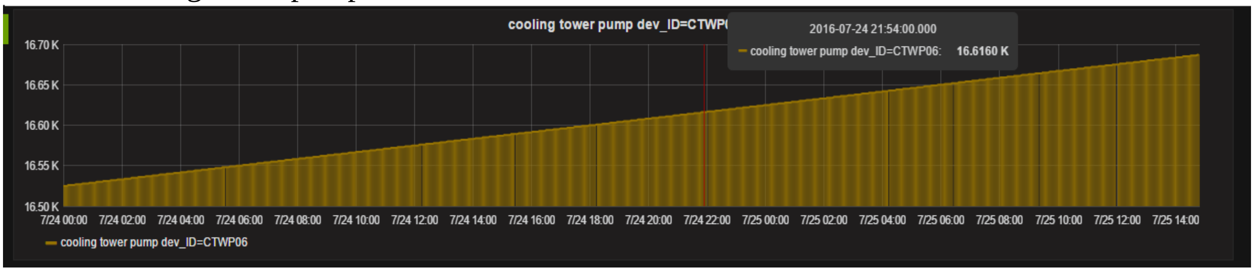
11. Make up air unit: units unknown



12. Cooling tower: units unknown

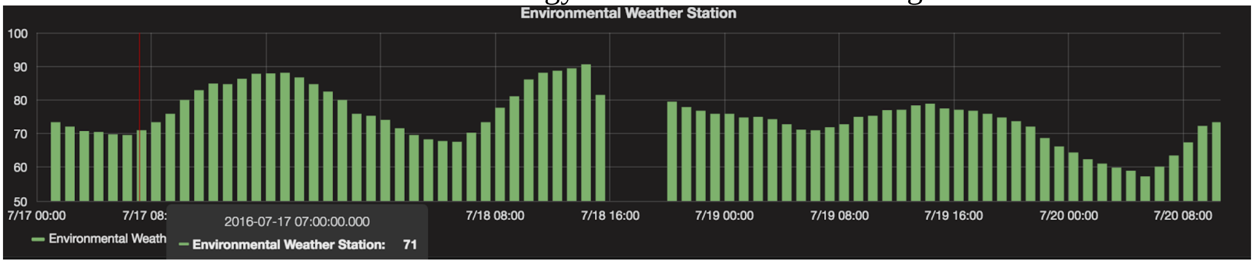


13. Cooling tower pump: units unknown



Dashboard:Weather Station: http://129.10.5.134:3000/dashboard/db/weather-station

1. Environmental Weatherstation (Fahrenheit): measures the wet bulb temperature. That is what determines how much energy it takes to cool the cooling tower water.



Dashboard: Electrical Generator: http://129.10.5.134:3000/dashboard/db/electrical-generator

1. GENC and GENF: there are two generators that supply backup power. GENF supplies power to Facility equipment (pumps, chillers, inrow coolers,etc). GENC supplies backup power to computing equipment.

General questions:

1. What do the ID's in electrical_meters mean?

John: the numeric ID is a hash, I believe. The ID in the JSON record identifies the location of the meter in the data center. It would be best, I think, to focus on the meters that matter, and not try to parse all of them.

Me: The ID's actually refer to the different layers the meters are located at. For example, some meters are located right at the entrance of the datacenter. These have some ID's that are different from, say, the meters that are located at each rack in the computing room.

2. Is data other than that from busplug (ex: mechanical IRC data) also scaled? This is because all of the temperatures in the IRC data are in the 700 ranges, so possibly there is a scale factor of 10.

Yes, IRC data is scaled by 10

3. Why is data from the cooling towers, chilling towers, exhaust fans, etc, so erratic? cooling towers, chillers, and exhaust fans to not run all the time, so you should expect to see values go to zero often.

4. Why don't we ever get any data from busplugs at Row 7 and 8 from pods A and B (the Redis database has no keys for those data metrics)

As noted in the computer room layout drawing, rows 7 and 8 only have C pods. There are no A or B pods.

Open questions:

1. For our purposes at PEAC lab, the granularity of the busplug and IRC data (1 minute) might be too large. Is there a way to get data every few seconds?
2. How do we connect the soft data coming from the servers to the power data coming from the busplugs and IRCs?
3. Is there a way to collect per pod data, per row data? InfluxDB doesn't allow us to parse tag values? Connection of servers, and racks and pod data
4. Can we calculate PUE in real time?
5. How will we synchronize the data collected from the physical sensors to the soft data from the servers?