Power Requirements for Mechanical System Redesign

As mentioned previously in the report, the changes to the mechanical system bring large changes to the electrical system. The most obvious change comes through the on-site generation on electricity. Other changes arise due to the use of less electrically driven equipment. Also, since the engine was sized to meet the electrical demand it is extremely important to the success of the system to accurately estimate the building's electrical loads. The building's electrical loads were calculated earlier in the report and can be found in the Building Load Analysis section.

There are three pieces of electrical equipment that are directly impacted by the changes in the mechanical system; they are Switchboards 8 and 26 and Panelboard EHVPAWG. In the existing design Switchboard 8 distributes electricity to Rooftop Unit A1, A3, and A4 in order to provide heating and cooling. Panelboard EHVPAWG supplies the same Rooftop units with the electricity needed for the supply fans. Panelboard EHVPAWG is fed through Swithboard 8 as well. Switchboard 26 distributes electricity to RTU-A2 to provide heating and cooling; however, due to an error in the drawings provided the supply fan in RTU-A2 does not have a power connection. This fan, which has been overlooked, will require an additional 21.3 kilovolt-amps(kVA) of electrical demand which will be addressed in the redesign. Figure 35 illustrates a riser diagram of the existing electrical design.
It should also be noted that both Switchboard 8 and 26 distribute power to sections of the Xanadu complex other than Building A. For this reason the listed demand loads will be higher than those discussed previously in this report.

In order to design the new electrical system the ampacities and voltages of all new equipment were taken from the equipment technical data. The sizing of new equipment, wiring, grounds, and conduits was based on equations and tables in the National Electrical Code (NEC) Handbook. When sizing wires in the redesign, copper or aluminum was used in the same situations as the existing system. As prescribed by the NEC Handbook, proper factors for continuous loads, number of current carrying conductors in a conduit, and ambient temperature were used where applicable. The results of the redesign are illustrated in Figure 36, which illustrates the redesign riser diagram. In order to power the new equipment a new panelboard has been installed, this panelboard will be fed by Switchboard 8. Overall the new equipment reduces the overall electrical demand by 354 kVA. It should be noted that a reduction between 300 kVA and 400 kVA depending on the time of year was found through the use of TRACE and the BCHP Screening Tool. This verifies that the electrical demand profiles used to design the engine were accurate. The overall equipment, conductor, and conduit take-off with prices can be found in Tables 8 and 9 for both the existing and redesigned systems.

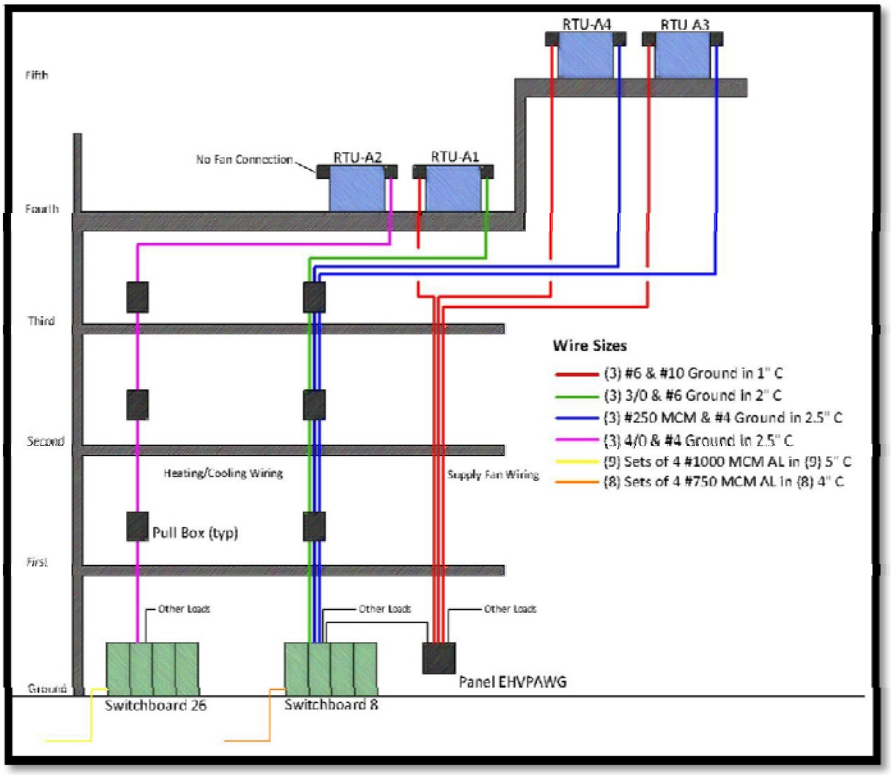

Figure 35: Existing Electrical System

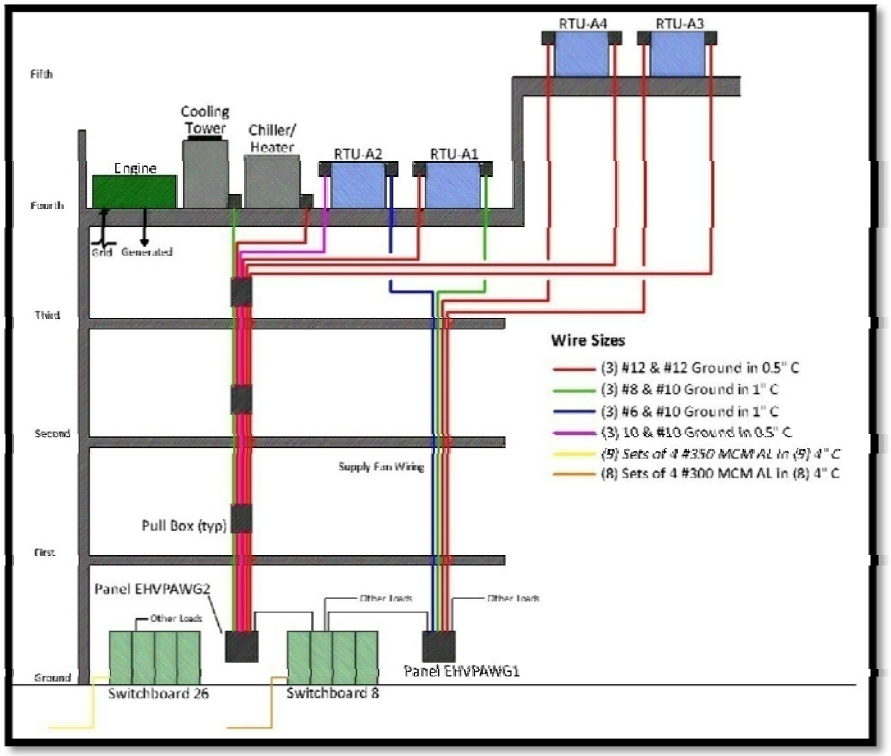

Figure 36: Redesign Electrical System

Table 8: Existing Electrical Cost to Change

Equipment Served	Wire Size	Length (ft)	Price/ 100 ft Conductor	Price/ 100 ft Conduit	Total Cost
RTU-A1 Supply Fan	(3) #6 & #10 G in 1"C	167	$152	12.4	$782
RTU-A1 DX	(3) #3/0 & #6 G in 2"C	179	$620	20.5	$3,366
RTU-A2 Supply Fan	(3) #6 & #10 G in 1"C	127	$152	12.4	$595
RTU-A2 DX	(3) #4/0 & #4 G in 2.5"C	71	$755	31.5	$1,631
RTU-A3 Supply Fan	(3) #6 & #10 G in 1"C	291	$152	12.4	$1,363
RTU-A3 DX	(3) #250 MCM & #4 G in 2.5"C	303	$895	31.5	$8,231
RTU-A4 Supply Fan	(3) #6 & #10 G in 1"C	248	$152	12.4	$1,162
RTU-A4 DX	(3) #250 MCM & #4 G in 2.5"C	260	$895	31.5	$7,063
Switchboard 26	(9) Sets of 4 #1000 MCM AL in (9) 5" C	126	$958	61.2	$43,532
Switchboard 8	(8) Sets of 4 #750 MCM AL in (9) 4" C	121	$815	54.5	$31,623
Emergency Gen	(3) #3/0 & #1/0 G in 5" C	405	$620	61.2	$7,781
Emergency Gen	(3) #3/0 & #1/0 G in 5" C	202	$620	61.2	$3,881
Emergency Gen	(3) #3/0 & #1/0 G in 5" C	430	$620	61.2	$8,261
					$119,270

Equipment	Size (Amps)	Total Cost
Switchboard S8	3000	$8,875
Switchboard S26	4000	$12,200

TOTAL COST:	**$140,345**

From Tables 8 and 9 it can be determined that a total savings of $79,591 is obtained through the electrical system changes. This is due to the reduction of electrically driven equipment. A direct benefit of the reduction of electrically driven equipment is the reduction of copper and aluminum in conductors and the reduction of the switchboard sizes. The savings produced from the electrical system redesign will be factored into the overall feasibility determination of the redesigned system in the Final Conclusions and Recommendation section of this report.

Table 9: Redesign Electrical Cost Changed

Equipment Served	Current (Amps)	Wire Size	Length (ft)	Price/ 100 ft		Total Cost
				Conductor	Conduit	
RTU-A1 Supply Fan	35	(3) #8 & #10 G in 1"C	167	113	12.4	$587
RTU-A1 Exhaust Fan	14	(3) #12 & #12 G in 0.5"C	172	67	8.6	$361
RTU-A2 Supply Fan	45	(3) #6 & #10 G in 1"C	127	152	12.4	$595
RTU-A2 Exhaust Fan	22	(3) #12 & #12 G in 0.5"C	132	67	8.6	$277
RTU-A3 Supply Fan	15	(3) #12 & #12 G in 0.5"C	291	67	8.6	$610
RTU-A3 Exhaust Fan	8	(3) #12 & #12 G in 0.5"C	296	67	8.6	$620
RTU-A4 Supply Fan	15	(3) #12 & #12 G in 0.5"C	248	67	8.6	$520
RTU-A4 Exhaust Fan	8	(3) #12 & #12 G in 0.5"C	253	67	8.6	$530
Switchboard 26	1819	(9) Sets of 4 #350 MCM AL in (9) 4" C	126	465	54.5	$21,161
Switchboard 8	1772.5	(8) Sets of 4 #300 MCM AL in (9) 4" C	121	445	54.5	$17,296
Chiller/Heater	11	(3) #12 & #12 G in 0.5"C	111	67	8.6	$233
Cooling Tower	40	(3) #8 & #10 G in 1"C	118	113	12.4	$415
						$43,204

Equipment	Size (Amps)	Total Cost
Switchboard S8	2500	$7,500
Switchboard S26	2500	$7,500
Panelboard EHVPAWG2	85.5	$2,550

TOTAL COST: $60,754