Memo

DATE: August 14, 2017
PROJECT: ASHRAE LowDown Showdown
TO: Competition Committee
FROM: Sustainability Savants
SUBJECT: Overview of Proposed Building Design

The climate in the Washington DC metro area is characterized by warm, humid summers; together with the stringent temperature and humidity requirements for the collections areas, this presents a significant challenge in designing an efficient system, with the target being minimizing energy usage (and thereby energy costs as well). In developing the model of the existing facility, the air system, with its large supply volume and high static pressure, was noted as the primary source of energy usage, between fan energy and space conditioning.

The approach taken, then, was to reduce loads in the collections spaces as much as possible, with the goal being to enable supply of *only* required ventilation air. Improving the insulation between the office and storage bays, and shading both the western façade and roof, reduce conductive gains. Infiltration is reduced by construction of vestibules around the external doorways for the storage bays, as well as an operational emphasis on never having a direct air path from either office or external air into the collections. Internal gains are relatively minor, but reducing the lighting gains via LED lighting with data center-style "follow me" occupancy sensing controls greatly lessens any additional cooling load.

These measures allow for an efficient dedicated outside air system, with 80% effective total heat recovery, to provide only the required ventilation air. The DOAS AHU utilizes a desiccant wheel with compressor heat for regeneration when available, as well as an evaporative pad humidifier, to serve the latent load that cannot be handled by the central DX coil. Large, low-velocity fans destratify the air, creating a uniform temperature and humidity. Any remaining load is met by passive chilled beams; these beams are connected via heat pump to a geothermal field consisting of 8, 300' vertical bores.

In comparison to the storage bays, the office is relatively straightforward; systems were selected that synergize with the storage systems as much as possible. The office area is served by a separate VAV air handler with airside heat recovery; water-to-air heat pumps connected to the geothermal field. A domestic hot water heat pump is also connected to the field to help balance heat rejection and extraction. As with the storage facility, LED lighting is used, with traditional office occupancy controls.

The canopy over the storage rooms, tilted at 5° above horizontal, serves the double purpose of shading the roof from direct solar radiation and housing 10,000 ft^2 of photovoltaic panels. These panels result in a 180 kW array that provides approximately one-third of the energy used by the proposed design.

After the inclusion of the PV array, the design EUI is 19 kBtu/ft^2/year, an 89% decrease from the 173 EUI of the existing building as modeled. This represents roughly $215,000 in electricity cost savings per year.