

## Executive Summary

This report details the mechanical system of our team's elementary school design for submission in the 2013 ASCE Charles Pankow Foundation Architectural Engineering Student Competition.

The team goals, which were selected to align with the Reading community, competition guidelines, and Charles Pankow Foundation mission, focused on creating a better community through integrated building design according to high performance standards. This translated mechanically to improved indoor environmental quality and reduced energy consumption.

The overarching theme of community established the backbone of the mechanical system design. The mechanical system was designed to allow the greatest ease of operation in multiple modes to match the varied functionality of the community facility. These modes were made possible through separation of heating, cooling, and air distribution systems into three activity-specific areas. The HVAC system was selected and designed through an integrated approach, which allowed factors affecting the mechanical system to be addressed by the entire project team. Likewise, early analysis of the overall building loads allowed for the collaboration of the mechanical and electrical systems, leading to an energy efficient and cost-effective design.

The process described above resulted in a mechanical design that can be summarized by the following statements:

- Building is separated mechanically to allow multiple operational modes that match the varied school and community based programs.
- Classrooms / Learning Areas are ventilated by a 100% outdoor air displacement ventilation (DV) system. Space heating and cooling is decoupled from ventilation loads, and is served through radiant heating floor slabs and radiant chilled ceiling panels, respectively.
- Community Areas and Pool Area are ventilated by an overhead mixing VAV system. The VAV system also handles all heating and cooling in those areas.
- Peak cooling load is 320 tons. Two chillers are installed in the building, supplying 45°F chilled water to air-handling unit cooling coils and 60°F chilled water to radiant chilled ceiling panels, respectively. Peak heating load is 2700 MBH. Three equally-sized boilers at 900 MBH each are installed to allow staging of part-load conditions.
- Combined heat and power (CHP) is utilized with four (4) 65 kW on-site natural gas microturbines, totaling 260 kW peak electric power and 1,100 MBH of peak collectable waste heat. The combined heat and power system will save the Reading School District approximately \$50,000 per year with the assumed schedule of operation. The lifecycle cost resulted in a 3.4-year discounted payback period assuming the design receives a federal or state energy grant.
- School is designed to apply for LEED Gold under LEED 2009 for Schools New Construction and Major Renovations. Design is applying for 61 LEED points, 32 of which are directly related to the mechanical system. Energy models predict that the building uses 29% less energy than the ASHRAE 90.1 2007 Appendix G Baseline model and is anticipated to receive an EnergyStar Rating of 85.