Executive Summary

The Salk Hall Addition is designed as an 81,116 square foot expansion of the existing Salk Hall laboratory. Salk Hall serves as an educational and research facility for the Department of Health Sciences, the School of Pharmacy, and the School of Dental Medicine at the University of Pittsburgh. Existing Salk hall was evaluated to determine necessary, or recommended, infrastructure upgrades and renovations in order to establish a program for the new building. The university re-started the design process in September 2009 after reducing the scope and budget from a larger project that was initially studied in 2008.

Overall, the designed mechanical system of the Salk Hall addition is appropriately sized and was found to adhere to local codes and industry standards. Laboratories often pose a greater design challenge than other buildings due to their large variation in internal loads and high ventilation requirements. The basis of design (BOD), with regard to the air-side system, incorporates a variable air volume design with enthalpy energy recovery. This system is capable of supplying the required ventilation airflow rate under full and part load conditions, as well as provided make-up ventilation air when fume hoods or biological safety cabinets are active. The hydronic system design incorporates a perimeter radiation heating system and a radiant floor heating system.

The estimated construction cost of the BOD's mechanical system is around 11% of the total building cost. This percentage is within an appropriate range, with respect to the fact that laboratories require a large amount of specialized equipment and associated architectural casework. Since the Salk Hall Addition receives its utilities from campus plants, the most expensive pieces of mechanical equipment are the air handling units. Variable air volume systems are conventional, easy to install, and easy to operate.

The operating cost of the building is dominated by the ventilation requirement of the laboratories. In order to supply the laboratories with a ventilation rate of 8 air changes per hour (ACH), the electrical system has to meet the high full load amp demand of the supply fans. Specialized laboratory equipment also drives the building's operation costs up with regards to

the demand on the electrical system. The variety of lab equipment that is associated with Salk Hall can yield power consumption densities of 6-8 watts per square foot. In total, the associated operating costs of the BOD total to roughly $520,762. This yields a ratio of $6.42 per square foot.

The Salk Hall Addition demands a large quantity of hot water for its terminal reheat units, perimeter radiators, and other heating coil applications. The BOD does not directly recover any energy from the campus chiller.

One issue that the BOD may come across is a lack of capacity if the future program of the building changes. The BOD lacks 3,794 CFM to the meet the TRACE 700 peak simulated cooling load. While TRACE load simulations are often very conservative, this simulated demand does not include duct losses and could be problematic if extra fume hoods or biological safety cabinets are added to the building program.

Two identical, 33,000 CFM Pinnacle Ventilation Units will be designed to handle the combined thermal and ventilation loads required by the Salk Hall Addition's design program. One unit will exclusively handle thermal comfort by providing the chilled beams with neutral supply air. The other unit will provide 70°F supply air in order to meet the ventilation requirements of the Salk Hall Addition. The National Institute of Health requires that fume hood laboratories have back-up ventilation & exhaust systems. The AHUs are identical SEMCO PVS-43 air handling units, and in the case of a failure, the functioning air handler will service the ventilation system. Areas such as the linear equipment corridors, which have extremely high sensible loads, have been designed to incorporate auxiliary fan coil units in support of the main cooling system.

At its most fundamental level, rating the performance of an HVAC system is most simply exemplified in its annual operating cost. The BOD was estimated to have an annual operating cost of $520,762. The more efficient design, utilizing multiple heat recovery applications, was estimated to have an operating cost of $302,659. When comparing the two designs, the chilled beam yields a **$218,103 savings per year**. The future of HVAC systems lies with being able to minimize their carbon footprint. The traditional cool-and-reheat system is estimated to produce

nearly 16 million pounds of pollutants annually. The active chilled beam system is estimated to produce around 10 million pounds of pollutants. The re-design would reduce Salk Hall's carbon foot print by 37.5%.