# Executive Summary

EMD Serono Research Center – existing lab building is a pharmaceutical research and development building. Majority of the building area are research laboratories and vivarium rooms. Large amount of ventilation are required for those types of rooms to maintain a safe and healthy indoor air environment. The primary goals for the project were to provide adequate air quality, thermal comfort, and consume energy efficiently. The long-term cost for operating the facility is also very importance.

The existing mechanical system has an electrical chilled water cooling plant and a gas fired central heating plant. Chilled water is generated by a water cooled chiller and an air cooled chiller to provide summer cooling. Steam is generated by two gas fired boilers and it is used for summer reheat, winter heating and humidification. Air is distributed throughout the building by variable and constant volume terminal boxes in each space. There are 3 air handling units in this building, one for office space, one for laboratory space, and one for vivarium space. Air handing units for laboratory and vivarium space provides 100% outside air to the space.

The proposed analysis of alternate systems involves the reduction of building load, improvement of thermal comfort and indoor air quality, as well as the reduction of energy consumption. Three analyses were performed to evaluate the possibility of system improvement by implementing Dedicated Outdoor Air System (DOAS) with Active Chilled Beam (ACB), applying heat recovery systems, and putting solar shading systems. Comparisons of the alternatives were based on the system's impact on energy consumption, thermal comfort, indoor air quality, space requirement, and cost.

To ensure the proposed systems function properly, an architectural study was conducted to determine the impact of solar shades on the building exterior views. An electrical study was also conducted to determine the adequacy of the existing mechanical switchboards to handle new mechanical loads.

DOAS/ACB with Runaround Coil and Solar Shading system was proven to be the most efficient and cost effective system for this building. Energy analyses showed that this system has the highest energy deduction of $81,023 per year. Cost analyses showed that this system has the highest first cost of $1,768,132 but a relatively low simple payback period of 7 years and 10 months. This system also has a relative low 30-year lifecycle cost when compare to other alternatives.

DOAS/ACB with Runaround Coil and Solar Shading system is able to provide significant energy saving, improves thermal comfort, lower background noise, improve indoor air quality for the occupants and also adds strong visual aspect to the building. Therefore, this system is chosen to be the best suitable system for design.