

# Queen Elizabeth Building

## State-of-the-Art Systems and Integration

### Situation

The Board of Governors of Exhibition Place needed to replace the existing mechanical systems in the Queen Elizabeth Building at Exhibition Place, Toronto. This goal was to be achieved at the lowest feasible cost. At the same time, it was necessary to reduce the impact on the building's occupants and keep disruptions to a minimum. The Board also wanted an energy efficient solution so that they could contribute to the Exhibition Place's goal of energy sustainability by 2010, while maintaining the same (or lower) operating and maintenance costs.

The initial design involved replacing the existing equipment in the building with new equipment in a rooftop configuration, as the location and size of the central plant room made it impossible to replace in accordance to the Board's consultant. However, this design did not meet the current budget requirements. Direct Energy, a partner with Exhibition Place, was requested to review the initial design and provide recommendations to achieve the same objectives for the Queen Elizabeth Building using a different approach.

The two options were reviewed according to a number of factors, including the mechanical system, energy performance, and first cost. Direct Energy's proposal resulted in a less costly mechanical system, lower annual maintenance costs and improved energy efficiency when compared to the initial design proposal.

### Solution

The Direct Energy design included a new chiller plant, new boiler plant, new building automation system, and refurbishment and renewal of the air handling systems. The existing chilled water loop was modified to a variable flow two-pipe change-over system with a heating injection loop. Variable speed drives were installed to ensure the energy efficiency of the new mechanical systems. Two-way control valves were installed on the hydronic systems and zone isolation dampers were installed on the fan systems, which will enable occupant load to be managed more effectively. Existing fan systems were refurbished and modified.

A new 180 ton variable speed, oil-less, compact FatMax Smartt chiller was installed in the chiller room. The new chiller plant includes a variable speed cooling tower, two variable speed main dual temperature circulating pumps, a variable speed condenser water pump, and system change-over valve. The existing cooling tower was replaced with a new variable speed cooling tower. Additional space gained in the mechanical room through the use of the compact chiller allowed the installation of new high efficiency hot water boilers.

The new boiler plant consists of two fan-assisted vertical copper-tube boilers, piped in a primary-secondary injection configuration. A low temperature bleed valve ensures that boiler minimum return water temperatures are achieved throughout the



heating season, while maintaining system temperature control and equipment life longevity.

Existing air handling units were updated with the addition of variable speed drives and BAS controls. New dual duty coils replaced the existing steam and chilled water cooling coils in the fan systems. Existing dampers and damper actuators were refurbished and updated. Fan bearings and motors were serviced or replaced as required.

A state-of-the-art, web-based, Invensys building automation system (BAS) was installed to control the cooling plant, heating plant and air handling units. This system integrates with other BAS technologies in the facility. It is an integral part of the retrofit, as it allows the equipment to provide heating, cooling, and ventilation in a very energy efficient manner. It is also time efficient, as the system enables building operators to troubleshoot problems more effectively, proactively monitor space conditions, and perform trend logging (review what happened before and after an incident).

Energy efficiency was maximized through the installation of variable speed technologies (oil-less centrifugal chiller, cooling tower, pumping, and fan control), 85% efficiency gas boilers, and integrated digital control of existing and newly installed systems.

"The solution proposed by Direct Energy was most welcomed by Exhibition Place when we thought there were no options left," says Dianne Young, CEO of Exhibition Place. "Once again, we were celebrating the very positive partnership that exists between the Board of Governors of Exhibition Place and Direct Energy Services."