



MOUNT PLEASANT SUBSTATION

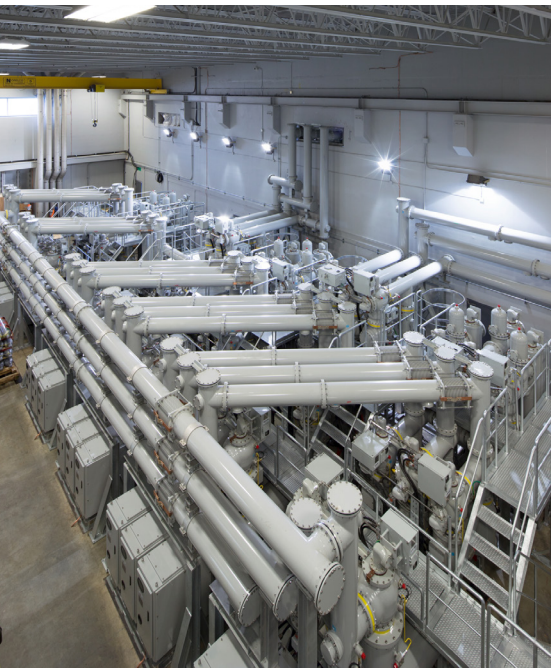




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MOUNT PLEASANT SUBSTATION

PROJECT INFORMATION

Location: 338 West 6th Avenue, Vancouver, BC

Completed: 2013

Category: E. Natural Resources, Mining, Industry, Energy

Entering Firm: WSP Canada Inc.

Firm Address: 200 - 1985 West Broadway, Vancouver, BC

Role: Prime Consultant, including
Structural, Mechanical and Electrical Engineering and Project Management

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Client: BC Hydro

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PROJECT OUTLINE

The Mount Pleasant Substation is the only publicly-visible portion of BC Hydro's Vancouver City Centre Transmission Project and an integral part of the most significant investment in Central Vancouver's electrical system in 30 years. Located in a residential neighbourhood, the 400 MVA substation provides reliable power, satisfies complicated urban design issues and features an aesthetically pleasing and sustainable design to meet a LEED Silver target.

INNOVATION

The Mount Pleasant Substation (MPT) building is the only publicly-visible portion of BC Hydro's Vancouver City Centre Transmission (VCCT) Project. It is an integral part of the most significant investment in central Vancouver's electrical system in 30 years. The VCCT project increases the reliability of the electrical supply throughout Vancouver and meets the growing demand for power in the South False Creek / Mount Pleasant area.

The 400 MVA Mount Pleasant Substation accommodates complex electrical equipment and operational requirements and is designed to post-disaster structural standards to ensure it continues to operate after a major earthquake. This resulted in significant concrete wall thickness and rebar content to ensure the facility will withstand the design earthquake. This created a challenge as electrical reliability also relies on redundancy of equipment and complex interconnectivity of that equipment to

permit continued operation in the event a single critical piece of equipment fails. Providing services and access / egress to secure equipment rooms was challenging as there was limited allowance for penetration of seismic shear walls and zonal rebar. Fire separation requirements were also complex due to the large penetrations of rated walls required for numerous cable trays and large conductors. This was addressed through detailed coordination and teamwork with BC Hydro's internal engineering group to accommodate complex electrical equipment and operational requirements into the design.

In addition to meeting post disaster requirements, the building structure needed to be slim enough to allow maximum space inside the building for equipment clearances and allow significant openings for cable penetrations and openings for various equipment. The heavily reinforced walls also needed to accommodate large grounding cables and rebar was



electrically isolated to prevent heating of rebar due to inductive currents generated by power conductors. Both epoxy coated rebar and fibre reinforced bars were employed. Since the walls needed to be as thin as possible, clearances for rebar were minimized. Pours as tall as 9 metres were required and all walls were poured using an Agilia self-consolidating concrete. This was the largest pour of Agilia mix in Vancouver, at the time.

Fire and life safety are paramount in any project. BC Hydro's safety requirements exceed most Code requirements, but complicated the building design. Containing potential explosions and fires from transformers and equipment in an urban location created enormous challenges. The main transformers were located on the east end of the site from a transmission and distribution point of view however this end of the site is most sensitive as it is bounded by residential development. Enclosures around the transformers attenuate noise as well and contain potential explosions and fire. A deluge system provides fire suppression and a dedicated drainage system prevents contaminants from entering the storm water system.



Control Room

COMPLEXITY

A key aspect of the project was incorporating a large, secure 400 MVA substation in a residential neighbourhood with a number of houses, apartment buildings and low-rise commercial buildings. This urban location meant using a smaller site than normal and locating all equipment indoors.

With a fixed site, it was not possible to enlarge the building to suit equipment. Areas of the site were also dedicated to public green space and landscaping to meet City development guidelines. Due to the constrained site, the building was designed with three floors with a floor-to-floor distance of 9m. One complete level is located below grade to reduce the exposed height of the building. This placed the bottom of the structure below the water table and thus required a tanked foundation design and groundwater drainage system. The design process implemented a “belt and suspenders” solution where all concrete below grade (slabs and walls) were poured with an integral waterproofing admixture with waterstops at all joints as well as using a water proof membrane on the exterior side of the slab to resist ground water pressure.

For safety, all interior and exterior metal components are connected to a complex station grounding grid to eliminate electrical shock hazards. Extremely detailed design was required to introduce ground wires into metallic building components where they are not typical, such as aluminum window systems, wall cladding, flashings and even handrails. In systems where unusual solutions were required, mock-ups were constructed to test the grounding before it was installed on site.

Due to the complexity of the building and equipment systems, the facility was designed using REVIT BIM software. All process equipment and interconnecting cable tray was also modelled in 3D. This enabled all systems to be checked for conflicts and generated useful information for the pricing of the project. This integrated design process and use of Revit BIM was extremely successful as there were only minor modifications required to the building to suit major equipment that arrived after the building was 90% complete.



Excavation and Basement Construction



Public Art Display along West 6th Avenue

SOCIAL BENEFITS

This project is crucial to improving the reliability and capacity of the electrical power system for the City of Vancouver. It accomplishes this while fitting into the urban fabric through its stepped massing, choice of materials and contributing positively to the neighbourhood through dedicated green space and public art that enlivens the façade.

BC Hydro is a Provincial entity that does not typically need to comply with local development guidelines or Building Codes. However, BC Hydro agreed to follow City requirements to seek public input into the design as this project is in a sensitive neighbourhood. A series of public meetings were held to inform neighbours of the project as the design progressed and to allow them to comment on the issues important to them. This resulted in a superior project design that received support from the City and residents.

Heritage-listed houses on the project site were derelict, but key components, including doors, hardware, floor boards, interior and exterior wood mouldings were carefully removed from the buildings prior to demolition and in compliance with hazardous building materials handling requirements. Components were stored on site and delivered to the Vancouver Heritage Society for use in restoration projects elsewhere in the City.

Typically the design approach for substation buildings is to place the enclosed equipment on a large area of drain rock, surrounded by a chain link fence in a simple pre-engineered building. The MPT project illustrates how the design team can produce a solution that fits the scale of the neighbourhood through stepped massing and appropriate materials, provides aesthetic benefits to the neighborhood through green space and public art, while still meeting the project objectives for safety, reliability and efficiency.

ENVIRONMENTAL BENEFITS

This project is unique in terms of sustainability as it does not fit the typical uses and building types for which the LEED rating system was developed. A special interpretation request was submitted to CaGBC at the beginning of the project to determine if the LEED system could be applied to this project. The initial sustainable design objective was to incorporate as many sustainable features as practical, but as the design developed, it became apparent that it was possible to achieve much more. The MPT is the first BC Hydro substation and first substation designed to meet LEED Silver requirements (LEED status pending).

LEED credits pursued include reducing heat island effect, water use reduction and use of low emitting materials. Innovations in design include a recycled content of over 22%, regional materials of over 30% and a green

housekeeping program. An educational program will be incorporated into the building and on a web site to promote the sustainable features and make staff/public aware of this achievement. Energy costs were reduced by 37% over the Model National Energy Code for Buildings.

The impact on the external neighbourhood was minimized through careful design of the lighting and process equipment, including acoustic treatment to attenuate noise from exterior equipment, such as the main power transformers. The interior work environment benefits from the use of natural light, careful lighting design, low VOC materials and segregation of equipment and working areas, where practical.

The landscaping and seating at the east end of the property provides community amenity space that did not exist before the project was constructed.



The Mount Pleasant Substation is the first substation registered to meet LEED Silver requirements.



BC Hydro's objectives for the MPT project were:

- High reliability after a design earthquake through post-disaster seismic design.
- An aesthetically pleasing design that meets City requirements and minimizes the impact on the community as well as incorporates durable materials to minimize maintenance requirements.
- A safe and ergonomic design to suit employees and the public.
- A sustainable design, resulting in reduced environmental impact and achieving LEED registered status.



MEETING CLIENT'S NEEDS

Traditionally, substations employ very functional and pragmatic design solutions, often with large metal-clad equipment and exposed conductors inside chain link fence enclosures, but the Mount Pleasant Substation is much different. This substation not only provides reliable power, but also satisfies complex urban design issues, provides an aesthetically pleasing but secure building through use of public consultation and integrated design processes. Through a stepped-massing design, creative use of materials, dedicated green space and public art, the project fits into the urban fabric and is the first substation on record constructed to meet LEED Silver requirements.

Executing a large complex project in an urban environment requires innovative design solutions. A combined team of 50

people worked together to complete the design within many constraints. Due to the complexity and technical/engineering challenges on this project, WSP and BC Hydro's most experienced personnel were assigned at the onset of design and followed through all phases of the project including construction. The project scope and team was managed through bi-weekly design team meetings where progress and key issues were tracked and resolved. The project duration, from conceptual design to construction completion, was six years and the final cost was within budget. The team worked closely and diligently to produce a solution that visually complements the neighbourhood, is environmentally responsible, while still meeting the project objectives for safety, reliability and efficiency.

