

PROJECT PROFILE

Total Constructions Central Thermal Plant - Stage 2 Power Systems Engineering

CDMS Electrical Engineering (CDMS) were approached to assist with the electrical design for the high voltage infrastructure of the Central Thermal Plant Stage 2 works.

OUTCOME

- Power system studies including protection, fault levels, load flow & arc flash.
- Function specification to interface the high voltage generators into the system.
- Protection design philosophy and protection relay settings.
- Generator commissioning assistance.
- HV protection commissioning procedures and assistance.
- Supply authority witness testing procedures and assistance.

BACKGROUND

The Central Thermal Plant is a district heating and cooling network in a residential setting that sets it apart from other designs. By centralising the generation of heat and cooling, rather than individual plant rooms for each building, you increase the energy and capital investment efficiency. By having a large plant it opens the ability to employ a co-generation system or more specifically waste heat recovery from the gas engine. The CTP generates hot water using natural gas, generates chilled water using electricity and generates electricity via a natural gas fed engine. Heat recovered from the gas engine is used to heat the hot water, thereby reducing the amount of natural gas that would otherwise be used if that heat was not recovered. Electricity from the gas engine is used to run the chillers. The Central Thermal Plant is on the site of the old brewery in the Broadway suburb of Sydney.

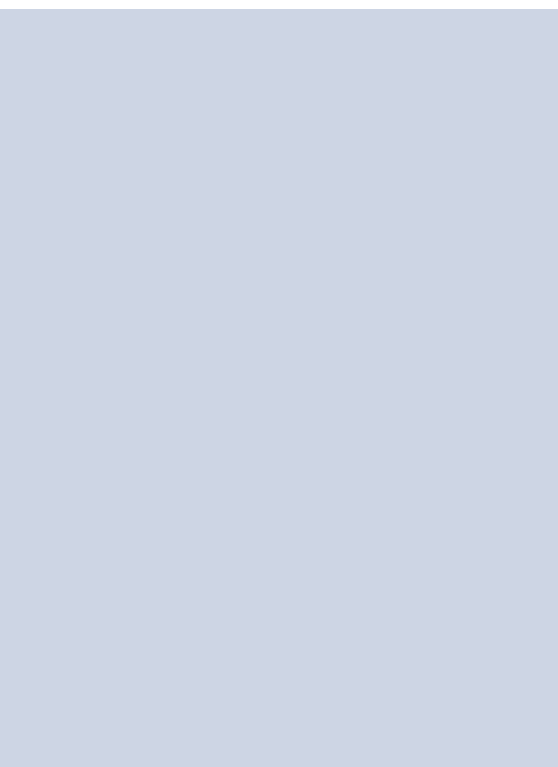
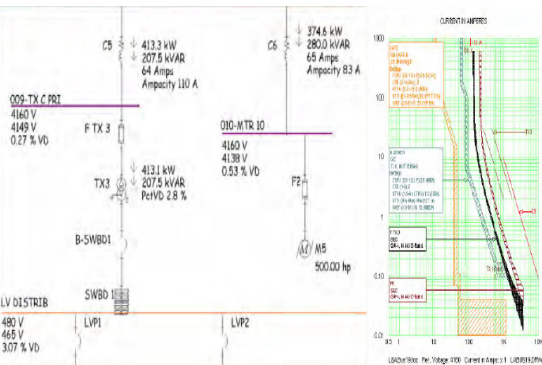
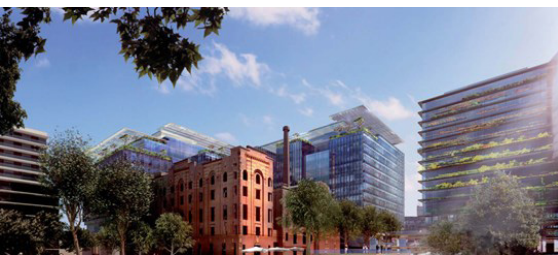
Stage 1 is located in the basement under the brewery building and contains a private substation, supplied at 11kV and containing a main 11kV switchboard supplying 4x 2MVA 11kV/433V transformers, 1x 1.6MVA 11kV/433V transformer and 1x 1.2MVA gas generator & interconnector to the CTP2 infrastructure.

Stage 2 is located in the basement of the adjacent building and contains a private substation, supplied at 11kV from CTP1 switchboard and containing an 11kV switchboard supplying 2x 2MVA 11kV/433V transformers, 1x 1.6MVA 11kV/433V transformer and 1x 1.6MVA diesel generator. A second 1.2MVA gas generator was installed in CTP1 as part of the stage 2 works.

PROJECT OBJECTIVES

The stage 1 design was expanded to cover stage 2 infrastructures. Power Tools for Windows was used to model the HV network and provide protection grading, load flow and arc flash analysis of the site. In addition to the stage 1 overcurrent and earth fault protection, the stage 2 also implemented transformer differential protection and Switchboard Bus Differential protection schemes. Design of all protection settings was implemented, and protection testing procedures were designed and implemented. Protection relays included SEL 751, 700G, 787 & 487B relays.

An interface design was implemented for the diesel generator to operate as a blackout generator to provide essential equipment supply and synchronise back to the mains on supply return. Associated HV switching required for isolation of the non-essential loads was also implemented in the generator interface functionality.



CHALLENGES

- Challenges were encountered in achieving adequate protection grading between the supply authority, existing stage 1 and the new stage 2 infrastructures. Consultation with supply authority and modified supply protection was required to achieve this.
- Interface design for the new gas generator to provide blackout backup supply for essential services and associated HV switching required for the generator operation was resolved by utilisation of a switching and generator interface PLC system.
- Site restrictions were placed on outages of the stage 1 infrastructure due to supply of customers, so all testing and commissioning was designed to minimise disruption to this supply.

OUR APPROACH

CDMS's approach where possible, was to utilise similar design concepts from the original stage 1 to provide synergy across the stages, and to expand these concepts to cover the additional requirements of stage 2. Transformer differential protection and Switchboard 2 Bus Differential protection was implemented in Stage 2 providing added protection for the equipment over stage 1.