



MOTOR CITY DCP



Concept & Location

Dubai Motor City is a unique project that offers residents, employers, business people and tourists an extensive array of sophistication, thrills, quality of life and possibilities. The Motor City consists of five components - Dubai Autodrome, Formula One Theme Park, the Business Park, and the residential areas that include Uptown Motor City and Green Community Motor City.

The vast Motor City area required a high capacity District Cooling plant to centralize the production of thermal energy in the form of chilled water and then distribute the chilled water to a range of residential, commercial and government buildings through an extensive network of underground pipes. Opting for a district cooling approach, instead of the traditional dedicated local system for each building delivered substantial economic and environmental benefits to the client.

For the residents and visitors, this also meant considerable reduction in ambient noise and better temperature control in homes, while building owners or landlords gained from reduced capital, operating and maintenance costs and substantial savings in electricity usage, since the Motor City DCP used 50 per cent of the energy required for conventional air-cooled chiller systems.

The Emicool District Cooling Company commissioned the services of DSE to design, build, install and test the District Cooling Plant at Motor City. There are two district cooling plants that serve the whole of the Motor City Development in Dubai.

Each plant has a total installed cooling capacity of 35,000 TR with a chilled water storage capability to supplement its total load at peak hours.

Plant 1 supplies chilled water to the Autodrome, uptown and parts of Green Community. Plant 2 supplies chilled water to show rooms, hotels, office towers, terrace apartments and parts of Green Community.

The Motor City DCP utilizes large capacity water cooled chillers; each plant consisting of 8 sets of chiller pairs for a combined capacity of 4,850 TR. The chillers are located on the ground floor, where the MV switchgear is also positioned.

8 primary chilled water pumps (PCHWP) and 12 secondary chilled water pumps (SCHWP) aid the circulation of chilled water with the motor control centre (MCC). The PCHWP's operated at a fixed speed and works in tandem with a number of operational chillers, whereas the SCHWPs operate at variable speeds controlled by the load conditions of the customers.

The cooling of chillers is facilitated by 8 cooling towers which are located on the roof. The condenser pumps (which circulate the water) are located on the first floor, where the MCC exists. The fans of the cooling towers are of the variable speed type and VFD for the same is located on the first floor. A thermal energy storage tank of 6,000 TR capacity is located on the ground floor. The volume of the TES tank is designed to hold around 4,150 m³ while the bulk water storage (civil construction) tank (located below the TES tank) is designed to have a capacity of 7,000 m³.



Scope of Work

DSE was awarded a contract to design and handle the construction management of the state-of-the-art district cooling plants and a chilled water underground piping network.

Drake & Scull's scope of work at the Motor City DCP included the following:

- Design and construction of two 40,000 TR District Cooling Plants.
- 8 x 2 lead/lag packaged chiller modules of 5,000 TR each.
- 8 Cooling Towers of 5,000 TR each.
- Associated MV/LV Switchgear.
- SCADA plant control and monitoring system.
- 7400 cubic meter ground water storage tanks.
- 5,000 TR Thermal Energy Storage Tanks.
- Operation and Maintenance for 2 years.

DSE was responsible for the design and development of engineering drawings, plant & material selections, procurement, installation, commissioning and performance validation of mechanical & electrical chilled water process plant for the District Cooling System.

Motor City DCP Challenges

DSE had to use chilled water as the cooling medium of choice for the District Cooling Plant. The plant room had to utilize electric driven centrifugal chillers having a total capacity of 39,000 TR for producing chilled water at 5 Degree Celsius, laid out in a Series-Counter flow/ Parallel pair arrangement as per design.

The chilled water system consisted of primary/secondary pumping arrangement with separate primary and secondary water pumps. The primary chilled water pump was to be driven by a single speed LV electric motor, while the secondary chilled water pump was to be driven by variable frequency drives.

The Thermal storage tank had to be above ground, insulated and jacketed with a size of 28 M x 23 M. The package control systems had to be included with a control interface to allow monitoring and control of selected points on the package systems. The chillers panel had to integrate a Modbus card to allow efficient monitoring, communication and full integration with the plant-room industrial control system.

DSE also had to undertake chemical treatment for all internal plant room piping and thermal storage tank, as well complete the initial fill, testing and draining of water and chemicals to the plant room internal piping and thermal storage tank.

The design of each plant required a basement floor which resulted in excavation and disposal of nearly 40,000 m³ of earth. DSE also had to deploy adequate equipment in a confined space for this works.



DSE Innovation

The design and installation of the Motor City DSE proved to be a unique learning experience. The challenges of the design and the geography meant DSE had to think out of the box and come up with several unique approaches to complete the plant within time.

One of the unique aspects of the District Cooling Plant was the TES tank (Thermal Storage Tank). The dimensions of the tank were 28 meters in diameter and 23 meters in height. The imposing tank had to be constructed out of carbon steel plates whose thickness varied from 24mm to 8mm, which were joined by welding.

The massive work undertaken meant that all in all, around 80,000 m³ of earth was excavated for both Plants. Around 55,000 dia inch pipes were welded and more than 150 tons of structural steel for pipe and equipment was utilized.

DSE also encountered freakish weather during the construction, particularly in the November of 2008, when the cooling tower structure erection works in Plant 1 was sabotaged by an unusually heavy storm. The storm damaged the structures erected for the cooling tower but proper planning by DSE ensured that any resulting delays were kept to a bare minimum.

DSE was able to completely insulate the central chilled water plant system, and the Condenser cooling water circuit was built with centrifugal pumps driven by single speed LC electric motors. The cooling towers were of industrial strength, counter-flow, field erected on concrete field constructed water basins, with variable frequency driven cooling tower fans.

The external valve chamber with proper housing isolations valves was connected to the external network successfully.

The condenser water circuit utilized a conductivity controlled blow down system.

The two concrete water storage tanks were located below the TES tank with a total net storage capacity of 7400 m³. Fresh water intake was used for the chilled water via a makeup pump set. The Waste and vent piping systems with all plumbing fixtures was proved in the plumbing system layout, in compliance with the design requirements.

A side stream filtration unit, with centrifugal separator was incorporated to automatically remove suspended solids in the condenser water, to minimize water losses and maintain the condenser circuit operating at peak efficiency and minimize maintenance. An additional basin vacuum cleaning system was provided to ease the periodic cleaning of individual cooling tower basins.

The plant performance was tested at 25, 50, 75 and 100% load conditions, to ensure that the connected cooling load was up to the task of cooling the plant room. The performance values were thoroughly calculated and submitted to the clients for review. This proved that the DSE's design decisions were able to achieve optimum energy efficiency at the lowest possible cost, over the complete operating range of equipment temperatures.

DSE was able to design; install, test and handover the Motor City DCP well within the time frame allocated by the client, and was able to deliver significant energy savings, as well as outstanding cooling performance. The Motor City DCP is a fine example of DSE's expertise with major district cooling plants.