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Further information
Skanska AB
www.skanska.com

Contact
Noel Morrin,
SVP Sustainability &
Green Construction
noel.morrin@skanska.se

DGS Central Utility Plant, USA

Case Study 67

The Department of General Services (DGS) Central Utility Plant in Sacramento, California, has been modernized with green and energy efficient equipment, and was constructed to meet LEED (Leadership in Energy and Environmental Design) Platinum certification.

Aspects of Sustainability

This project highlights the following:

Social Aspects

Human Resources

Corporate Community Involvement

Business Ethics

Health and Safety

Environmental Aspects

Energy and Climate

Materials

Ecosystems

Local Impacts

Economic Aspects

Project Selection

Supply Chain

Value Added

Project Introduction

The DGS Central Utility Plant, situated in downtown Sacramento, provides chilled water for cooling, steam for heating, and control air to 23 state-owned buildings in the Capitol Area. The utility plant serves over 500,000 m^2 of state-owned office space in which approximately 20,000 employees work. The plant was constructed on the site of a less efficient central utility plant, which was built in 1968 and struggled to meet the increasing demands for heating and cooling.

Skanska USA designed and constructed the 7,200 m^2 plant as part of a US$ 181 million design-build contract for the DGS that was completed in November 2010. The plant consisted of entirely new buildings and structures, which was more cost effective than retrofitting the old plant. The old plant was fully operational during construction and was demolished once the new plant was completed. The new plant includes a steam boiler plant with 4 gas-fired water tube boilers. The new chiller plant consists of variable speed electric chillers, cooling towers and a 38 m high 16,000 m^3 Thermal Energy Storage (TES) tank, which stores chilled water for use during peak hours. A steam turbine generator was also installed to provide emergency power to the chillers in the event of a power failure or during peak shaving scenarios.

The project team surpassed the LEED (Leadership in Energy and Environmental Design) Gold contract requirement by building the plant to LEED Platinum certification, which is the highest level possible. LEED is a voluntary U.S. Green Building Council (USGBC) certification process intended to encourage and guide the construction of more sustainable and energy efficient buildings. The team incorporated state-of-the-art equipment to use less energy and water and ensure the plant met LEED Platinum. The plant also no longer

discharges warm water into the Sacramento River and complies with the Central Valley Regional Water Quality Control Board temperature criteria.

Contributing Toward Sustainable Development

DGS Central Utility Plant provides more reliable and efficient heating and cooling systems, which have reduced energy costs and greenhouse gas emissions. The plant is also more water efficient, generates a proportion of its own energy from solar arrays and has reduced outdoor noise emissions. During construction, Skanska promoted good community relations and the team met high standards of occupational health and safety. The project benefitted the local economy by employing people from the Sacramento area and by utilizing regional construction materials and subcontractors. Skanska worked to minimize the environmental impacts of construction and large proportions of construction and demolition waste were recycled to avoid landfill.

Social Aspects

Stakeholder communication and dialogue

A public information program was implemented during the design and construction of the plant. The program included a project website, which was managed by the DGS to communicate project progress and provide neighborhood updates. Skanska mailed monthly project status reports to neighbors in a four-block radius of the project. Considerate contractor signage was also located around the site with contact telephone numbers for the public to discuss any questions or concerns.

Project team communication

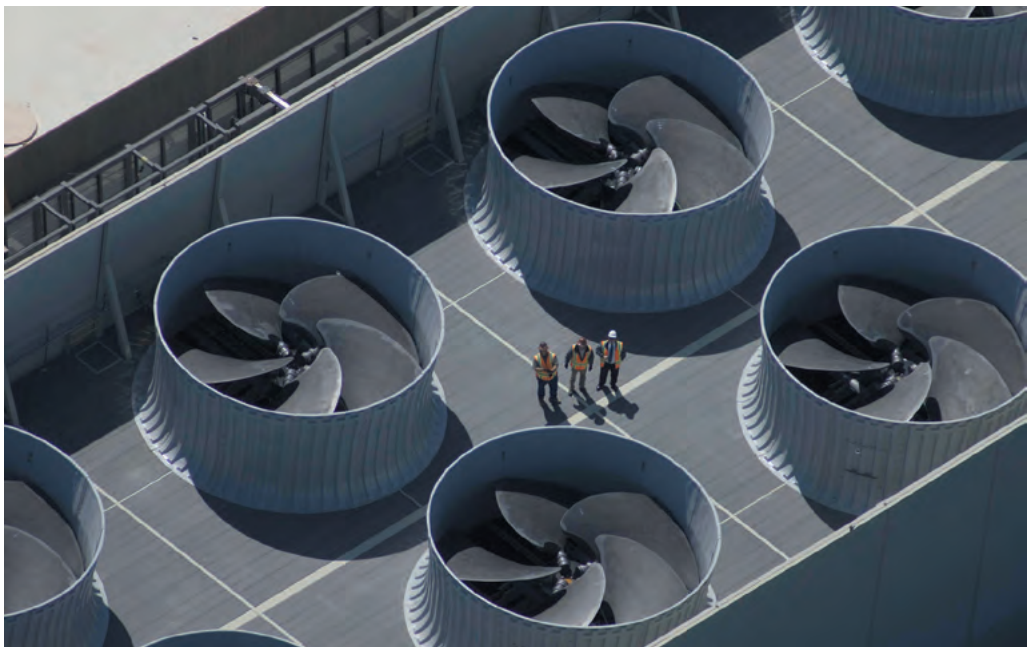
Skanska established a construction management portal, which enabled the entire project team to communicate quickly and consistently. The portal included a secure online project plan database, which contained plans and designs that could be viewed and edited by authorized users. The portal also contained a project calendar and an online environmental management control system.

Occupational health and safety

The Lost Time Accident Rate was zero as of January 2010. A safety leadership team was established during preconstruction to oversee the project safety program, monitor monthly performance and identify safety risks. Skanska's Injury Free Environment (IFE) program, which includes "stretch and flex" warm-up exercises for workers, was implemented on site. The project also worked with an Owner Controlled Insurance Program (OCIP), which emphasized accident prevention and safety.

High quality indoor environment

The office space is equipped with CO_2 monitoring and demand based ventilation control systems to ensure excellent indoor air quality. Non-toxic and low VOC (Volatile Organic Compound) substances, such as finishes, were also used to avoid indoor air pollution. Large windows and glazed façades maximize indoor day lighting for plant employees and visitors, and sunshades prevent glare from the sun.



More reliable heating and cooling

The plant has greater capacity to meet the present and future heating and cooling demands from the buildings it serves. The plant meets the long-term projected heating requirements and can be easily upgraded to meet the long-term cooling requirements by adding an additional electric chiller when required. The TES tank and the emergency on-site power generation facilities enable the plant to operate off-grid in the event of a disruption to the plant's power supply.

Sustainable urban planning

The Central Utility Plant was constructed on the site of the old plant and did not impact upon greenfield land or natural habitats. The plant is situated in downtown Sacramento with good access to services, amenities and public transport. The plant has secure bicycle storage, and shower and locker facilities are available to staff in order to promote sustainable transportation.

Minimizing public noise disturbance

The plant is located in a built up urban area and noise disturbance has been minimized by selecting low-noise equipment and by soundproofing. Equipment that emits less than 85 dBA was selected and low-noise machinery includes super low sound cooling tower fan blades. The plant's walls and ceilings are soundproofed and acoustic blankets were installed around particular machinery. Pipe and ventilation openings were also designed to minimize external noise emissions.

Economic Aspects

Construction employment

The construction workforce varied in size from 75 to 600 full-time construction employees and the majority of the team was from the Sacramento area. During the peak project workforce period between November 2008 and July 2009, the project paid approximately US$ 3.5 million dollars in monthly payroll into the local economy.

Local construction materials and subcontractors

The project prioritized local construction materials and subcontractors and 35 percent of the work was contracted to local businesses, which amounted to US$ 62.7 million. Small and disadvantaged businesses were also prioritized, including companies that supplied the structural concrete, interior casework, landscaping, testing and some design services. Locally manufactured or quarried products included the stone veneers, masonry products, concrete and aggregates, interior finishes, gypsum wall products, and reinforcing and light gauge steel materials.

Reduced energy costs and long-term financial savings

The plant uses 58 percent less energy than the old plant, which has significantly reduced operational costs for the DGS. The TES tank reduces cooling costs by avoiding cooling water during peak hours when electricity is more expensive. The tank also spreads the cooling load throughout the day, which avoids the need for additional chillers during peak periods. The initial investment for the new steam boiler plant is estimated to be repaid within 2 years due to the use of flue stack economizers and other energy enhancements, and the chilled water plant within 6 years due to significantly reduced energy consumption.

Environmental Aspects

Construction and demolition waste management

The contracting of efficient off-site recycling services minimized project waste. In total, 89 percent of all project waste was recycled and diverted from landfill. The old plant was also demolished and 91 percent of demolition waste was diverted from landfill.

Reducing the environmental impacts of construction

Dampening areas of the site with water reduced dust and street cleaners were used to keep adjacent roads clean. Special low-noise construction equipment was used to minimize noise pollution. Materials with high-recycled content were selected and over 20 percent of the construction materials contained recycled content, such as steel and carpets. The mat-slab foundations, which distribute wall loads across an entire building area, also contained 30 percent fly ash.

More efficient heating and cooling

The plant is highly efficient and is designed to use 58 percent less energy than the old plant, which corresponds to savings of 28,000 kWh per day. Highly efficient heating and cooling equipment include the steam heating plant and the evaporative cooling plant. The cooling plant predominantly operates at partial load as it stores cooled water in the TES tank, which provides cooling during peak periods. The TES tank has double the required insulation to reduce heat gain to less than 1 percent over a 24-hour period in the summer. The plant's

heating and cooling capacity can be varied to more accurately meet demand and reduce energy wastage. The plant is equipped with a performance monitoring system and the post-occupancy performance will be monitored for 2 years with the objective of further enhancing plant efficiency.

Energy efficient building

An occupancy and demand ventilation control HVAC (Heating, Ventilating and Air Conditioning) system was installed, which uses 70 percent less energy than the current ASHRAE (American Society of Heating, Refrigerating and Air-Conditioning Engineers) standard. The office cooling system is capable of either evaporative cooling or refrigerant based cooling, and automatically selects the most energy efficient cooling method under the prevailing conditions. Low-energy evaporative cooling is used when atmospheric conditions allow rather than refrigerant based cooling, which requires more energy but can be more efficient in periods of high humidity. External shading avoids overheating in summer and high performance low-E glazing helps to insulate the buildings. The extensive use of natural day lighting reduces the need for artificial lighting, and efficient lighting with occupancy sensors was installed.

Reduced greenhouse gas emissions

The reduced energy consumption of the plant annually saves over 4,300 tons of CO_2. The plant is also equipped with combustion air preheating and low NOx natural gas burner assemblies, which minimize combustion emissions of CO_2, CO, NOx and ozone. NOx is a potent greenhouse gas that is 300 times more effective at trapping heat than CO_2.

Water efficiency

The plant uses 90 percent less water than the old plant, which makes daily savings of over 14,000 m^3. Water from the cooling tower is reclaimed for toilet flushing and landscape irrigation. No potable water is used for site landscape irrigation. Water efficient fixtures in the building have reduced water consumption by over 30 percent compared with baseline figures for the building. Gardens and landscaping on the site reduce stormwater runoff.

Reduced impact on the Sacramento River

The new plant uses evaporative cooling towers and no longer discharges warm water into the Sacramento River. The discharge of warm water from the old plant could reach 15,500 m^3 per day during the maximum summer load. The plant therefore has less impact on aquatic systems in the river.

On site renewable energy generation

The facility is equipped with solar water heaters that provide 90 percent of the domestic hot water supply for the office. The plant is also equipped with an 11 kW photovoltaic array that generates 17 percent of the plant's power requirements.

Environmental public awareness

Permanent educational display boards of various sizes are hung in the viewing area overlooking the chiller plant. The DGS also provides information brochures and guided tours to educate visitors of the sustainability aspects of the plant.

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Aesthetic enhancement of the site

The 1960s plant was replaced by a modern design, which was intended to blend into the surrounding architecture and enhance the aesthetical attractiveness of the site. The design minimized the height of plant structures and arranged tall edifices, such as the TES tank, in the centre of the site to reduce the scale of the plant and the shading of surrounding buildings. Planter boxes and canopies on the mezzanine level also help to reduce the scale of the plant. The plant design incorporated the TES tank as an attractive landmark feature, which is wrapped in a blue and white metal insulation jacket designed to give the appearance of water sparkling to the top of the tank. The building footprint of the site was reduced and some of the open space was landscaped into gardens with various plants and trees. 6 existing trees were removed to make way for the plant, but Skanska planted 15 new trees in the new landscaped areas to compensate. A magnolia garden was created to the north of the site, which preserved an existing cluster of magnolia trees. The garden is open to the public and contains benches, paths and a water feature that reuses water from the plant.

Reduced urban heat island effect

The site has been designed to reduce the urban heat island effect by minimizing the extent of dark surfaces. The roof of the plant and hardscape around the buildings are all light colored, except for a small area of asphalt paving for parking. The existing large trees were preserved and incorporated into the design to provide shading for the building and the adjacent pedestrian walkways.

Learning From Good Practice

The plant incorporates state-of-the-art equipment and design features, and is a showcase for green and energy efficient technologies. Much of the equipment has short payback periods and the plant has the potential to make significant long-term financial savings throughout its operational lifespan.