NEMETSCHEK Allplan

Hydroelectric power plant Middle Marsyangdi, Nepal | Building Company DYWIDAG International GmbH

Green electricity from hydro power

Alternative, environmentally sound energy systems are gaining momentum in almost all countries in the world. This has led to a need to exploit and develop renewable energy sources such as photovoltaics, solar heat, wind and hydro power. The construction of the Middle Marsyangdi Power Plant in the Lamjung District of Nepal (around 170 km west of Kathmandu) has made it possible to utilise the country's central hydro power resources. Klaus Klafke, Project Manager at DYWIDAG International GmbH, relied upon Allplan Engineering for the planning phase of this major project.

The Middle Marsyangdi Hydroelectric Power Plant consists of a number of structures, some above ground and some below the surface. In order to make this possible, the planning and construction phases had to run smoothly in addition to being coordinated precisely with each other. “The project included a retaining dam with an overflow structure, underground caverns, the six kilometre headrace tunnel and surge tank, various service buildings and important access roads. Only the machine house containing the turbines was built by our Chinese partner China International Water & Electric Corporation (CWE). This building was fitted out with systems supplied by Siemens,” explains Project Manager Klaus Klafke. As a firm specialising in power station construction, DYWIDAG was contracted to build the entire installation. With 7,200 employees, the company takes on challenging construction projects throughout the world. One of its main focal points is in the area of infrastructure projects, such as the construction of buildings associated with energy generation.

The seamless integration of each of the individual sub-projects was essential to the optimal conversion of the water’s mechanical energy into electrical power and achieving maximum output. The overflow structure in the retaining dam uses three integrated steel doors that act as a weir to regulate the water level. The stilling basin is located directly behind the overflow structure. If the steel doors of the overflow structure are opened, the water cascades downwards at an enormous rate. This creates a vortex, the energy of which is absorbed by the concrete-reinforced stilling basin. Subterranean desanding caverns filter out the quantities of sand introduced by the river. From here, the stilled, filtered water enters a 6 kilometre headrace tunnel which, in this narrow valley, is almost entirely beneath the mountain. The naturally meandering river is straightened by the tunnel and is diverted in the direction of the machine house, where the turbines are driven by the inflowing volumes of water and generate power. “It took around two years just to build the tunnel and install the associated piping, with a diameter of 5 metres. The tunnel excavations took place almost exclusively beneath the mountain. In this remote region with limited access, this type of excavation work had to be carried out and secured appropriately by experts,” states Klaus Klafke.

Geographical complications

The small, Himalayan nation of Nepal is characterised by its abundant sources of water and the natural altitudinal fluctuations of its landscape, making it ideally suited for the generation of hydro power. However, planning the construction of a dam in this geologically recent mountain region also entails considerable difficulties. One of the challenges during the construction of the Middle Marsyangdi Power Plant was presented by working in the steep, narrow valley as Klaus Klafke recalls: “Key components of the power station were installed underground. The fact that the substrate consisted of fragile rock only became apparent once construction had begun. This had a major impact on plans, which often had to be revised accordingly or even completely abandoned in some cases.”

Intense monsoon rainfall also complicated the construction project. Under normal conditions, around 70 cubic metres of water flow down the Marsyangdi mountain river per second. However, during the rainy season from June to September, this minor river morphs into a raging torrent, with up to 1,200 cubic metres of water coursing through the narrow valley each second. In order to divert these vast volumes of water in the direction of the turbines, the project called for the construction of solid units. But it was only possible to undertake their construction during the dry season, leading to significant delays.
In addition to the planning difficulties, the project team also had to cope with logistical and organisational challenges such as the procurement of materials in this underdeveloped region. Although sand and stone was in rich supply on site, all other construction materials had to be imported from Europe. These were transferred to the Nepalese border after first arriving in India. From there, they had to be transported a further 500 kilometres on Nepal’s roads, some of which are very poor.

High performance in reinforced concrete design

"Without Allplan, we would not have been able to handle the specific characteristics of this project as well as we did," comments Klaus Klafke. Since 1990, the company has been using Allplan Engineering to plan all its projects. "No matter whether you're designing reinforced concrete or creating project plans, this software ensures that your workflows are smooth. In our opinion, Allplan is the optimal solution for all construction require ments." In the Middle Marsyangdi project, the use of Allplan Engineering significantly optimised the creation of the reinforced concrete plans. "The challenges facing engineers around the world are growing in magnitude. We can only complete complex construction projects on schedule and on budget by using a professional, reliable software package. The Nepalese planners on site were also highly impressed by the sophisticated reinforcement program and the intuitive user interface," concludes Klafke.

The powerstation which opened in December 2008 will make a key contribution to covering the region's energy requirements in the future with an output of 72 megawatts and the ability to generate 400 gigawatt hours annually, "This power station generates clean electrical energy and will also help to boost the Nepalese economy and its development," says Klaus Klafke.