

**Luang Prabang, Lao PDR** – Laos has been actively pursuing its target to become the “Battery of Southeast Asia” by exploiting its vast hydropower potential. With up to 18,000 MW available, more than 9,000 MW can be harnessed from the Mekong River alone. Although developers are drawn by the vast potential for renewable energy production, they must also recognize the need for sustainable development.

Governing bodies such as the Mekong River Commission and the Lao Ministry of Natural Resources and Environment are

tasked with the challenging responsibility of striking a balance between the benefits of hydropower while mitigating its environmental impact. The key to sustainable use of renewable energy is the careful selection of the best sites and adherence to internationally recognized environmental and social standards during construction and operation of the power plants.

#### THE PROJECT

The Luang Prabang Hydroelectric Power Plant is located more than

25 km upstream of the Town of Luang Prabang. The site has been carefully chosen to satisfy all necessary hydrological and geological requirements.

Downstream of the project, the Mekong flows naturally towards the town of Luang Prabang with its iconic peninsula created by the confluence of the Mekong and the Nam Khan River.

In order to protect the environment, CK Power, one of the region's largest producers of electricity from renewables, recognized



**"The newly designed Kaplan runner is, in addition to delivering the highest discharge capability, one of the largest and most powerful Kaplan runners in the world."**

#### TECHNICAL DETAILS

Total output: 1,460 MW

Head: 26 m

Voltage: 500 kV

Runner diameter: 9,100 mm

Speed: 83.30 rpm

Average Annual energy production: 6,500 GWh

Luang Prabang





Successful hydraulic model acceptance test in April 2023, witnessed by representatives of CK Power, Ch. Karnchang and consultants of AFRY, achieving all guaranteed efficiencies

**“Luang Prabang is fully compliant with internationally recognized environmental and social standards, including IFC Performance Standards and the Equator Principles.”**

→ early on the potential benefit of renewable hydropower for the growing energy needs of its home country, Thailand. Drawing on its expertise in the realization of large infrastructure projects, CK Power successfully completed the development and construction of the Nam Ngum 2 and Xayaburi hydroelectric power plants with the latter setting a new benchmark in regard to fish protection and socially compatible infrastructure development.

With Xayaburi as the largest hydropower plant on the Mekong up to date, CK Power took the next step by starting the development of the Luang Prabang project. As is typical of hydropower projects, Luang Prabang HPP offers its own set of unique challenges.

Having learned valuable lessons regarding the effectiveness of the environmental and social mitigation measures at Xayaburi, and seeking further optimization, CK Power incorporated proven design features and introduced new solutions into the plant design.

#### **RECORD-BREAKING HYDRAULIC DESIGN**

Based on the hydrology and powerhouse geometry, ANDRITZ took on the challenge of pushing the envelope of what is hydraulically possible. Starting with the already high-performing turbine setup of the Xayaburi hydropower plant, ANDRITZ embarked on a project-specific hydraulic development journey using computational fluid analysis tools and testing the results on the test rig in Linz, Austria. The results of these efforts are extraordinary: The new turbine design for the Luang Prabang plant features a Kaplan



turbine with a runner diameter of 9.1 m, an extremely wide operating range with a head ratio factor of 2.3 (H max/H min) and the world's largest discharge capacity of more than 950 m<sup>3</sup>/s.

Conventional design limits were redefined, and special design features were conceived and introduced during the development process. The result of this extraordinary effort is a unique Kaplan design which defines a new benchmark. The newly designed Kaplan runner is, in addition to having the highest discharge capability, one of the largest and most powerful Kaplan runners in the world. The hydraulic static and rotating components of Luang Prabang HPP exceed all expectations with respect to performance and fish friendliness.

### ENVIRONMENTALLY FRIENDLY PLANT DESIGN

Highest efficiency and an excellent cavitation behavior over the entire operation range are not the only remarkable achievements of the design phase. Apart from its unique hydraulic performance, the turbine design incorporates the latest environmentally friendly design features. Besides the oil-free runner hub, fish-friendly design features are applied to hydraulic components like wicket gates and runner blades. Performance optimization goes hand-in-hand with these fish-friendly features, with smooth pressure gradients and small gaps helping in both respects. Results of actual measurements with sensor-fish performed at Xayaburi are being considered in the design of Luang Prabang HPP. As an example, the particularly inclined wicket gate design leads to a reduction in the gap between

wicket gates and the bottom ring in full load situations and substantially increases fish survival rates.

Besides the applied environmental hydraulic and mechanical design aspects, provision of dedicated fish passage facilities for both up- and downstream migration are a key factor in achieving state-of-the-art fish passage rates at the Luang Prabang HPP. An attraction flow system guides fish upstream from the tailrace while producing energy via three dedicated 20 MW units, which are also supplied by ANDRITZ.

Apart from the turbine-generator units, ANDRITZ is also supplying the auxiliary equipment, as well as the automation and control systems, which are instrumental in keeping water levels within the narrow operating band and important for safeguarding habitats along the Mekong River.

### DESIGN AND CONSTRUCTION WORKS

In the design process, ANDRITZ engineers are using multi-dimensional Building Information Modeling (BIM), a highly collaborative design and engineering process which facilitates collaboration between contractors, consultancy firms, and the operations and maintenance management of the plant owner.

With the access roads, a new bridge across the Mekong River, and site



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[Overview construction site Luang Prabang](#)



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[Survey work on the river bank on start of civil construction](#)

facilities completed, the EPC contractor, Ch. Karnchang Lao, is progressing with the construction of the main cofferdams and the left pier wall. This helped achieving a flood-safe construction pit before the onset of the flood season in 2023. In addition, excavation works for the powerhouse, the spillway, and the navigation lock are also progressing. Draft tube installation is scheduled for early 2024 with commissioning works anticipated to be completed by mid-2029.

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