FIELD VISIT TO LAXAPANA COMPLEX

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INTRODUCTION

Hydro-power is a power that is derived from the force or energy of moving water. Hydroelectricity is the term referring to electricity generated by hydro-power; the production of electrical power through the use of the gravitational force of falling or flowing water.

OBJECTIVE

At the lower end of the scheme, where the powerhouse is situated, the goal of a hydroelectric scheme is to transform the potential energy of a mass of water flowing in a stream with a specific fall to the turbine (referred to as the "head") into electric energy. The scheme's power output is proportional to both the head and the flow. The potential energy of dammed water powers a generator and water turbine, providing the majority of hydroelectric power. The volume and height differential between the water's source and outflow determine how much power is taken from it. We refer to this disparity in height as the head. The head of the water determines how much potential energy it contains.

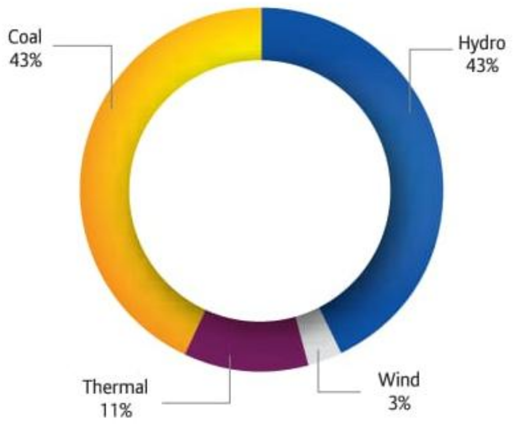

Figure 01: CEB electricity generation at 2022

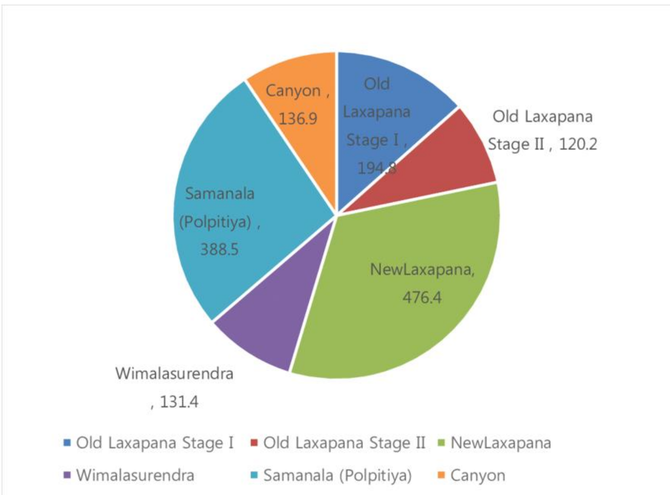

Figure 02: Laxapana power generation in GWh

HISTORY

The “Blackpool power station” (Wimalasurendra power station) was the first small hydroelectric power station in Sri Lanka. It was built by Mr. D.J. Wimalasurendra at 1912. It took about 9 years to complete and it gave the electricity to Nuwara-Eliya in firstly. He revealed to the government about his huge hydroelectric power project. It’s huge plan is to construct the Aberdeen Laxapana (Old Laxapana) power plant by crossing Kehelgamu Oya and constructing a dam.

Figure 03: Blackpool power station

This was first started in 1924. The construction of the Norton reservoir with a water capacity of 320 acre feet is the first step here. Then, with the construction of the dam , the work on the power plant began. But due to the second world war, the work of this power plant was temporarily stopped in 1927. Again in 1938 this project was implemented. In 1942, the work was stopped due to the war. After that, in 1946, the work was started here again. But due to heavy rain between 15th and 27th of August at 1947, twenty people in the tunnel died and all their own property was destroyed. Due to this untimely disaster, then the Transport and Public works minister Sir Jon Kothalawala promised that if the work on the power plant is successfully completed, the Makara pantheon at Sri Padasthan will be built and electricity will be provided to it. On March 4, 1950, the work of the power plant was completed and electricity was provided to Sri Padasthan.

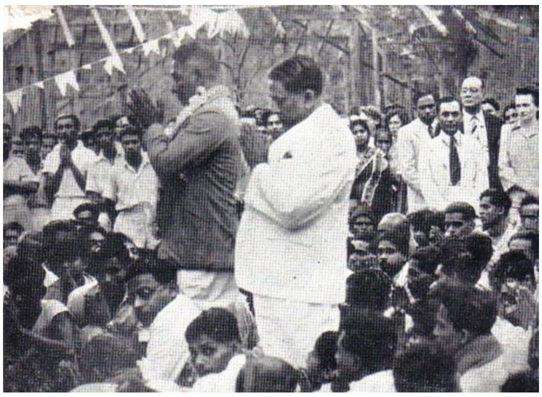

Figure 04: Sir Jon Kothalawala promised, electricity will be provided to Sri Padasthan

Sri Lanks's transmission system first started with the addition of this power plant. On october 30, 1950, this transmission system was connected to the Stanley power station and the work started here. This added an electricity capacity of 25MW to kolonnawa substation. After that, with the establishment of regional electrical engineering offices in Norton bridge, Nuwaraeliya, Diyathalawa, Panadura, Negombo, Avissawella, Peradeniya, this was spread across the country.

This image below shows the first turbine and generator was used at Old Laxapana power station. Form October 30, 1950 to around 2012, these machines provided service and when the efficiency decreased to 78%, these machines were removed and updated with new machines.

Figure 05: Old machine that was used to produce electricity

LAXAPANA COMPLEX

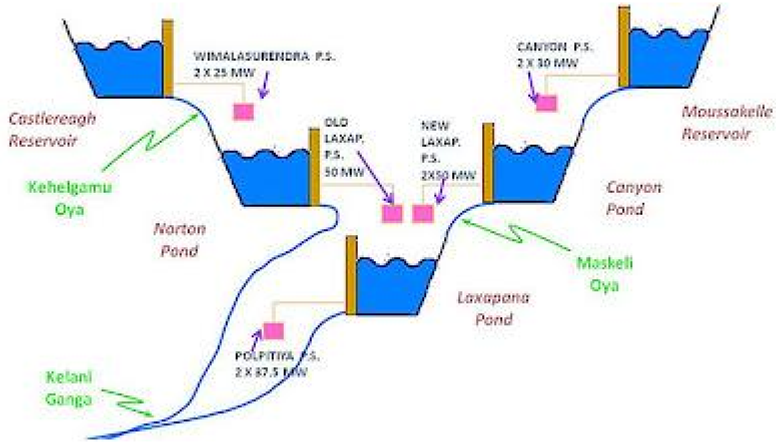

Figure 06: Laxapana complex

Given that its six power plants are located along Kehelgamu and Maskeli Oya, the Laxapana Complex is also known as the Kehelgamu-Maskeli Oya complex. Castlereagh Reservoir is the primary major reservoir at the summit of Kehelgamu Oya, where rainfall from the catchment region above the reservoir is gathered. It has a capacity of 1,000,048 m^3 and this powers the Blackpool power plant. Maussakelle reservoir is Maskeli Oya's primary reservoir. Maussakelle reservoir has a capacity of 1,000,123.4 m^3.

Figure 07: The tunnel for Kehelgamu Oya

Water from the Castlereagh reservoir is transported by a power tunnel to the Wimalasurendra power station, where it powers two hydro turbine-generators with a combined 25 MW capacity. Norton Pond, a small reservoir, collects the water discharged from Wimalasurendra power stations after they are operational. Norton Pond has a capacity of 1,000,000.4 m^3. This water is transported to the Old Laxapana power station via a different tunnel in order to run five turbine-generator units—three of which are 8.33 MW in size and the other two are 12.5 MW. Following the operation of the Old Laxapana machinery, the water released is collected in the Laxapana pond. It has a capacity of 1,000,000.4 m^3.

In the same way, the two Canyon machines, each with a capacity of 30 MW, are powered by water collected in the Maussakelle reservoir and transported via a tunnel. Canyon Pond has a capacity of 1,000,001.2 m^3 and it collects the water that is released following operations. To run the two 58 MW New Laxapana machines, this water is sent down another tunnel. As Old Laxapana machines, these two devices discharge water into Laxapana Pond.

To run the two 37.5 MW machines at the Samanala power station in Polpitiya, water gathered in Laxapana Pond is transported via a tunnel. Kehelgamu oya and Maskeli oya create the Kelani river, which receives water discharged from Samanala machines.

The final and newly added power plant to the Laxapana complex is the Broadland power station. The water for the Broadland Power Station comes from the Maskeliya Oya and Kehelgamu Oya, which are both tributaries of the Kelani River. The water is diverted through a dam system near Kitulgala to generate electricity at the power station. In Broadland's two machines are run, each with a capacity of 17.5 MW.

Figure 08: Norton pond

Figure 09: Pipes that are used to get the water form Norton pond to Old Laxapana power station

OLD - LAXAPANA

Water from two penstocks is divided into four penstocks and then divided into five to spin five turbines to generate electricity. The Old Laxapana power station was completed in two stages. In the first stage, on 30 October 1950, electricity with a capacity of 25MW was released to the Kolonnawa substation. The second stage started in 1953 and in 1958 it was integrated into the national grid. It also has a capacity of 25MW. Accordingly, in two stages, a capacity of 50MW was added to the national grid by the Old Laxapana power station around 1960.

Figure 10: Old Laxapana power station

Figure 11: Five machines that are used in Old Laxapana

Figure 12: Four Penstocks that are used in Old Laxapana

NEW - LAXAPANA

On September 17, 1974, the New Laxapana power station was added to the national grid. Out of this, two 50MW machines produce 100MW of electricity.

Figure 13: Two machines that are used in New Laxapana

BROADLAND

Broadland Power Station is a hydroelectric power plant located on the Kelani River. It is one of the country's newer hydropower projects, commissioned to enhance the nation's renewable energy capacity. The plant has an installed capacity of 35 MW and utilizes water from the Maskeliya Oya, a tributary of the Kelani River.

Figure 14: Broadland power station

This figure shows the main key elements in a hydroelectric power station.

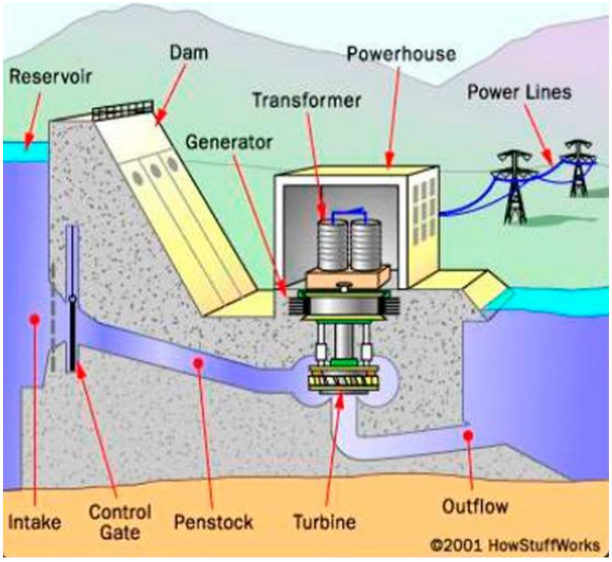

Figure 15: Hydraulic power station

- Dam

The Laxapana dam collects water from the Old and New Laxapana power plants to take the water to the Samanala power station in Polpitiya below. The capacity of Laxapana pond is about 164 acre feet. The dam is 26.4m high and 103m long. The speciality here is one of the oldest concrete dams in Sri Lanka like Norton-bridge and Castlereagh dam.

Figure 16: Laxapana Dam

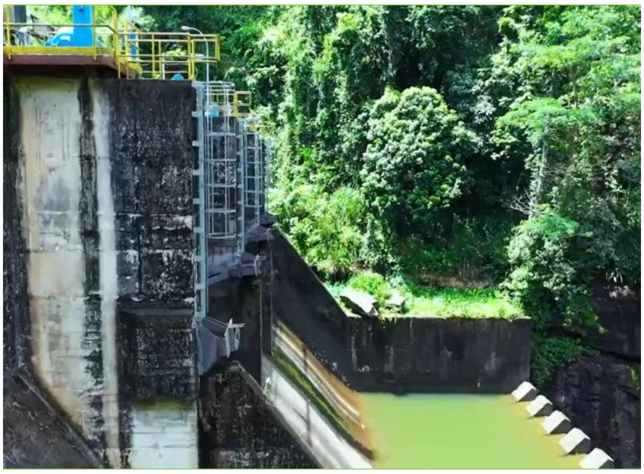

Figure 17: Side view of Laxapana Dam

- Intake

An intake is a structure that regularly releases water for hydroelectric power generating, water supply, etc. Without having an adverse effect on the surrounding ecosystem, a water intake must be able to redirect the necessary volume of water into a penstock or power canal.

- Penstock

When the gate opens, the water flowing through the penstock transforms from stored energy into kinetic energy since it is moving. There are four penstocks in Old Laxapana power station and they operate five generate by dividing in these four to five.

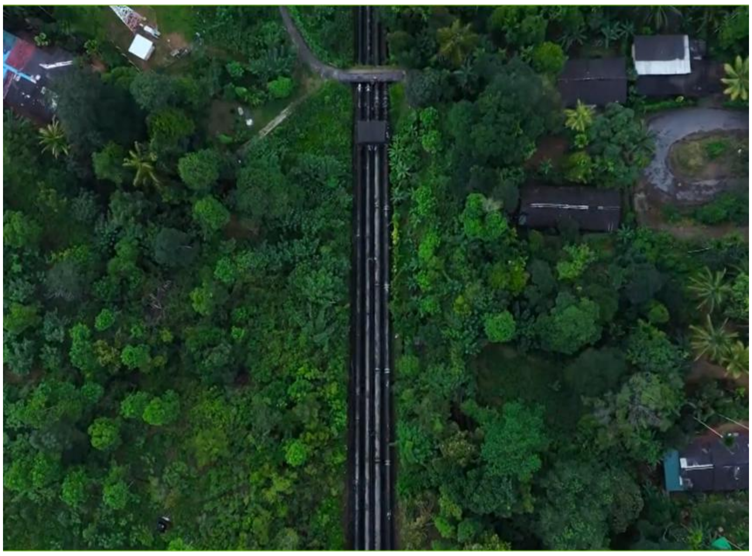

Figure 18: Penstocks

- Turbine

A hydraulic turbine also referred to as a hydro turbine or water turbine transforms the energy of flowing water into mechanical energy via a revolving shaft that is connected to a generator. The three most popular varieties of hydraulic turbines that have been created are the Francis turbine, the Kaplan turbine, and the Pelton turbine.

Classification of hydraulic turbines :

1. Based on flow path
    - Axial flow hydraulic turbine
    - Radial flow hydraulic turbine
    - Mixed flow hydraulic turbine
2. Based on pressure change
    - Impulse turbine
    - Reaction turbine

The Old Laxapana Power Station uses radial flow turbines-specifically Pelton turbines. These are impulse turbines, designed for high-head applications, which is suitable for Laxapana due to the significant elevation difference at the site.

New Laxapana uses pelton turbines, which are mixed flow turbines-meaning the water flows both radially and axially as it passes through the turbine.

Figure 19: Pelton turbines that are used in Old Laxapana

- Generator

A machine that transforms mechanical energy into electrical energy is called an electric generator. It serves as the hydroelectric power plant's key component. Rotating a number of magnets inside wire coils is the fundamental method of producing electricity. Electrons are moved by this action, resulting in electrical current.

Each generator is made of certain basic parts,

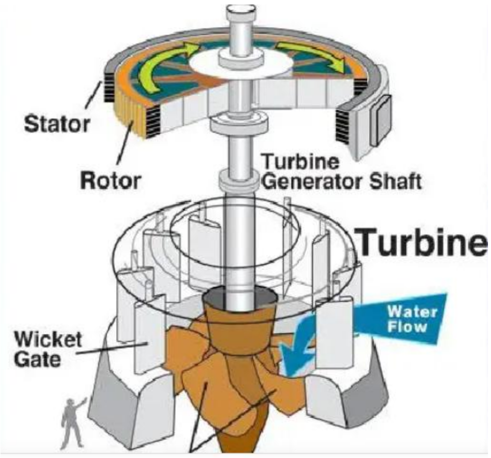

Figure 20: Basic parts of generator

- Surge chamber / tank

To produce the electricity by crossing the high level water by a dam and carrying the water through high pressure and low pressure pipes (penstocks) to hit the turbines and turn the turbines. Turbines need to be shut down as a turbine safety measure in case of any fault condition. In the event of an emergency shut-off, the high-pressure water starts moving up these pipes again. At the bottom of the search chamber is the high-pressure pipes and the top is the low-pressure pipes. High pressure pipes can handle the high-pressure coming up but low-pressure pipes can’t. Therefore, this high pressure is released through the search chamber. A high pressure pipeline is usually more than 1200m long.

Figure 21: Surge chamber

Next the main part of the power station is operation center because it operates all noise machines in a small room. Now days, both New and Old Laxapana power stations are operated at same operation center. In below, you can see the current chief engineer at Laxapana power station is Mr. Susil Karunananda.

Figure 22: Eng. Mr. Susil Karunananda

In long time ago, Old Laxapana was the oldest and biggest hydraulic power station in Sri Lanka. In that days, Canyon, Wimalasurendra, Samanala power stations were included in Laxapana complex. Now days, Broadland power station also included in Laxapana complex. In below, you can see the old operation center that were used to control all power stations in Laxapana complex. After some times, this operation center was replaced with new one but also now days this operation center has been preserved because it has a valuable history. A unique feature of the Laxapana power station is that it is able to produce electricity for 50% to 55% of the year.

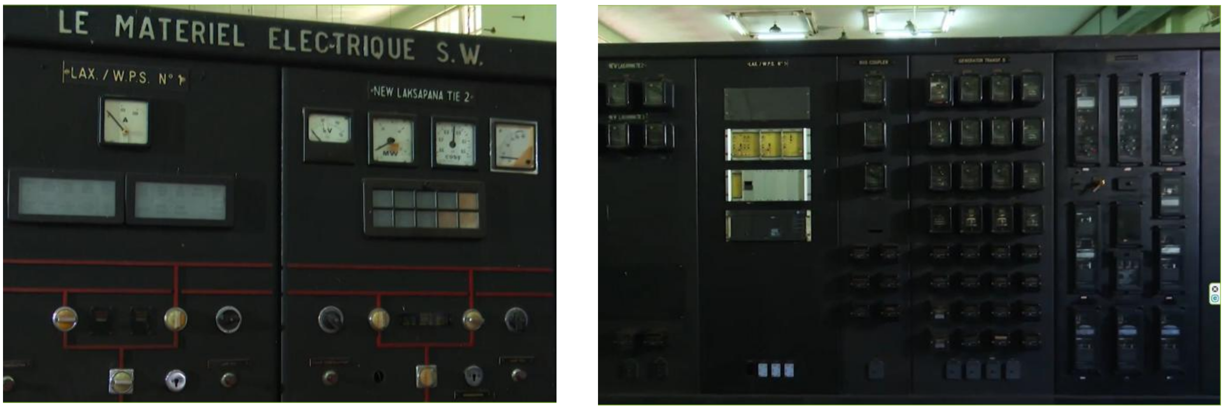

Figure 23: Old operation center placed at Old Laxapana