

Introduction to the Seminar on Upper Kotmale Hydropower Project (UKHP)

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1. Background

To meet the high growth rate of demand for electricity, CEB's Long Term Generation Expansion Plan envisions commissioning of several power plants on a periodic basis, ensuring the country an uninterrupted supply of power.

The demand for electricity in Sri Lanka is increasing around 6%-7% annually. About 95% of the households in Sri Lanka have access to electricity. The power supply situation in the country has stabilized with the commissioning of 300MW Coal Power Plant in the year 2011 and 150MW Upper Kotmale Hydropower Plant in year 2012, along with the commissioning of several small Diesel Power Stations and nearly 600MW Combine Cycle Power Plants running on heavy diesel or furnace oil.

Establishing these power plants is a very significant achievement in the Power Sector during the last two decades. Upper Kotmale Hydropower Plant was planned to be commissioned in the year 2009 as an important Power Plant to contribute significantly to meet the growing demand for electricity.

The implementation of Upper Kotmale Hydropower Project was done under extreme social and environmental pressure. The main emphasis of Upper Kotmale Hydropower Project is that the Project was implemented minimizing environmental impacts of a major project. The Project is aimed to harness the potential of natural source of energy while saving valuable foreign exchange used for alternative power generation by saving billions of rupees for other development work in the country.

The Project area is situated in the South Central mountainous range of Sri Lanka and administratively belongs to Nuwara-Eliya District. It covers the upstream catchment of the existing Kotmale reservoir on the Kotmale Oya, a tributary of the Mahaweli Ganga.

A concrete diversion weir was erected close to Talawakelle Town across Kotmale Oya establishing a reservoir in a 25-hectare area. The water of the reservoir is diverted to the Power Station in Niyamgamdora through a 12.9 kilometer long tunnel. The underground powerhouse is located at close proximity of Niyamgamdora village in Kotmale Divisional Secretariat Division.

The Power Plant of Upper Kotmale Hydropower Project consists of two Francis type Turbine units. Each unit has the capacity of 75 MW. The water from the Power Plant is discharged to the existing Kotmale reservoir through a tailrace tunnel. The power generated from the Plant is transmitted to existing Kotmale Switchyard through a 220kV Double Circuit Transmission Line. The expected average annual generation of the Power Plant is 409 GWh.

The total cost of the Project is US \$ 446 million. The former Japan Bank for International Co-operation (JBIC) merged recently with Japan International Cooperation Agency (JICA) granted a US \$ 297 million a 40 years Soft Loan with an annual interest of 0.95% to 0.75% per annum with a 10 year grace period.

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An additional loan was granted by the Japan International Cooperation Agency for US \$ 49 million payable in 40 years at the annual interest rate of 0.10% to 0.05% per annum to meet the cost variations of the Project.

The Upper Kotmale Reservoir was impounded in December 2011 and the commissioning test of the Power Plant commenced immediately thereafter. The first machine was commissioned in March 2012 and the second machine was commissioned in June 2012.

2. History of Planning the Upper Kotmale Hydropower Project

Upper Kotmale Hydropower Project was first identified in the 1960s under the Food and Agriculture Organization of the United Nations (FAO) study where five different power plants associated with both Agra Oya and Nanu Oya the two main tributaries of Kotmala Oya were to be developed. However, with the Mahaweli Development these projects were not immediately picked up for implementation. With the accelerated Mahaweli Programme, attention was focused again to the development of upper reaches of Kotmala Oya.

This was further studied in 1985-1987 to examine the feasibility of hydropower options in upper reaches of Kotmala Oya under the Japan International Cooperation Agency (JICA) technical assistance. In the feasibility study five dam sites together with eight alternative schemes were examined and the feasibility study report concluded, the development of two stages is technically and economically feasible. The two stages comprised of one resource type development at Caledonia and a run of river development at Talawakelle. The Project at Caledonia affected 2700 families by inundating large area of tea estates.

Caledonia Scheme	(Reservoir Type)	44MW
Talawakelle Scheme	(ROR Type)	204MW

Followed by the feasibility study, the Government of Japan provided a loan for Engineering Service Study in 1992 under the Overseas Economic Cooperation Fund (OECF). The Engineering Service Study included the review of the feasibility study, selection of the optimal development plan, the development of detailed design and preparation of tender documents and Environmental Impact Assessment Report.

During Engineering Service Study (September 1993 to March 1994) an optimization study was conducted to review the feasibility study and to formulate updated optimum plan. The following planning criteria were considered for formulation.

- Economical optimization in the supply system
- Minimum impact on environment
- Maximum utilization of water resources

The following alternatives were studied.

Alternative 1:
150MW Talawakelle and 40MW Caledonia developments (both commissioning in year 2001)

Alternative 2:
150MW Talawakelle commissioning in year 2001
40MW Caledonia commissioning in year 2005 or 2010 or 2015 (3 cases)

Alternative 3:
150MW Talawakelle only commissioning in year 2001.

The alternative 3 was selected as optimal development plan. The final design report was completed in June 1995.

The Environment Impact Assessment (EIA) identified the key issues associated with the UKHP as impacts on waterfall aesthetics due to flow reductions, social impacts due to resettlement of affected people, possible effects on ground water due to tunneling, impacts due to de-watering of streams on downstream water uses and impacts on bio-diversity.

3. Environmental Clearance and Approval for the Project

The Ministry of Irrigation, Power and Energy the Project Approving Agency (PAA) submitted its approval to implement the project, for the concurrence of Central Environmental Authority (CEA) in February 1995. CEA refused to grant concurrence to the approval given by PAA. However, on an appeal to the Secretary of Ministry of Transport, Environment and Women Affairs in 1995, he upheld the decision of the CEA but allowed CEB to re-submit for the environment approval of the Project after detailed study of the new alternatives mainly the Yoxford Alternative. Further due to this decision, detailed study on project alternatives was completed in year 1996 and the approval was sought from the CEA for the implementation of the Project. This too was turned down by the CEA and CEB appealed against the decision once again to the Secretary of Ministry of Forestry and Environment.

The Secretary of the Ministry of Forestry and Environment granted approval for the Project under the National Environmental Act in July 1998 subject to strict adoption of proposed mitigation measures to minimize the possible environmental impacts. The development of Watershed Management Plan, monitoring of groundwater level, assessment on bio-diversity, proper management of tunnel ways and Resettlement Action Plan were insisted with the above approvals. In the decision of the Secretary, Ministry of Forestry and Environment he specifically stated that *"I trust that the CEB will act in a responsible manner to undertake the Project as an example to prove how environment and development can be integrated."* The approval was challenged in the Court of Appeal in October 1998.

Subsequent to the settlement in Court of Appeal, in March 2000 the Secretary of the Ministry of Forestry and Environment in terms of the National Environmental Act issued final order allowing Ceylon Electricity Board (CEB) to implement the Project subject to strict adoption of the proposed mitigation measures.

Later with a grant from Japan Bank for International Cooperation (JBIC) under Special Assistance for Project Formulation (SAPROF), the Project Proposal was reviewed in March 2001. Under this project review, the engineering designs, tender documents and environmental and social impact studies were taken into consideration. The SAPROF team provided a frame work for the Project Implementation. This SAPROF study included the mitigation measures anticipated in the Environmental Clearance approval.

The Government of Sri Lanka secured financial assistance from the Government of Japan under the Loan Agreement SLP 74 signed on March 28, 2002 to implement the Project. The decision of the Secretary, Ministry of Forestry and Environment was further strengthened by the regulations gazetted under the National Environmental Act No. 47 of 1980 on April 10, 2003 by the Minister of Environmental and Natural Resources. The CEA was empowered to appoint an Environment Monitoring Committee (EMC) to monitor the implementation of the proposed mitigation measures by the CEB.

This committee comprises of representatives from 23 agencies and was chaired by the Director General of Central Environment Authority.

However, with the commencement of project activities due to political pressure from the regional politicians, decision was taken by the Cabinet of Ministers to curtail the Project confining it to the diversion of Kotmala Oya abandoning all six tributary intakes.

In the original design of UKHP, seven tributary intakes of Kotmala Oya was to be utilized. These tributaries were Kotmala Oya, Devon Oya, St. Andrews Falls, Pundal Oya, Puna Falls, Pun Oya No. 1, Puna Oya No. 2, and Duncinen Oya.

For the physical design of the Project, the following catchment and discharge measurements were considered.

Intake	Catchment Area (Km ²)	Annual Mean Discharge (m ³ /s)	Max. Intake Discharge (m ³ /s)
Main Stream	310.6	13.20	36.9
Devon Oya	24.0	1.45	3.1
Pundal Oya	23.5	1.13	2.4
Puna Falls	7.3	0.35	0.7
Puna Oya No. 1	9.1	0.49	1.0
Puna Oya No. 2	19.3	1.01	2.2
St Andrews Falls	3.4	0.19	0.4
Total	397.2	17.82	

With this original project proposal, average annual generation of 528GWh per annum was expected. However, with the above Cabinet Decision to curtail the Project only to main stream the expected average annual generation was reduced to 409GWh. This decision has reduced the annual production by 22% and the project cost by 12%. Hence the economic advantages of these tributaries diversions were unfortunately lost to the country. However, still the Project has been developed by keeping the access to implement the tributary diversion in future.

4. Implementation

The Project was implemented under five separate lots and according to the Loan Agreement conditions, the six contracts including Consultancy Services were awarded to the Japanese under the Japanese bidding. The details of the contracts are as follows.

The detail scope of works of the five contract lots are given below.

Lot 1 - Preparatory Works - Contract was awarded on July 27, 2005 to Maeda Corporation of Japan

No	Name of the Contract	Name of the Company	Period	Value (Million)
1	Consultancy Contract	J-Power	2003.11.05 to 31.12.2017	2,359 JPY + 734 LKR
2	Lot 1- Preparatory Works	Maeda Corporation	2005.07.27 to 2014.04.09	662 JPY + 6,830 LKR
3	Lot 2-Main Civil Works	Maeda-Nishimatsu Joint Venture	2006.12.06 to 2013.09.30	7,726 JPY + 5,609 LKR
4	Lot 3 -Hydro Mechanical Works	Kurimoto Ltd	2007.11.21 to 2011.09.30	2,060 JPY + 789 LKR
5	Lot 4-Electro Mechanical Equipment	Mitsubishi Corporation	2008.06.20 to 2014.04.30	7,973 JPY + 585 LKR
6	Lot 5 - Transmission Line	Kinden Corporation	2009.10.06 to 2012.01.05	738 JPY + 723 LKR

Preparatory Work includes,

- Construction of new access roads with drains, culverts and bridges
- construction of a New Bridge (83m length) across Kotmale Oya at Talawakelle
- Widening & Improving existing road Talawakelle-Tawalantenna of 33 km
- Among the new constructions there are 495 houses, 33 shops, 6 workshops, 6 libraries, 2 churches, 3 Kovils across all resettlement sites.
- A major benefit for the children can be identified in the form of a new school (Talawakelle Tamil School) of 8 buildings with modern facilities such as auditorium, canteen, and quarters for the principal.

- Three storied Urban Council building with all facilities.
- Modern buildings for rest house, playground and cinema hall in keeping with standards of Film Corporation.
- Permanent facilities for the CEB staff and consultant's staff
- New 32 km, 33kV double circuit electricity distribution lines.

Lot 2 - Main Civil Works - Contract was awarded on December 6, 2006 to Maeda - Nishimatsu Joint Venture of Japan

Main Civil Work is the largest lot under the Upper Kotmale Hydropower Project which includes,

- Construction of Intake Dam
- Construction of Underground Headrace Tunnels
- Construction of Underground Power House Complex and Switchyard
- Construction of Underground Tailrace Tunnel

The Underground tunnel will traverse from Talawakelle to Niyamgamdora under the Great Western mountain range and reach Niyamgamdora through Pundaluoya differ based on the geological structure. The deepest depth of the tunnel will be 450 metres and the shallowest depth of the tunnel will be 4.5 metres along the tunnel trace. The geological surveys were carried out along the route of the tunnel and the expressed confidence that there would be no obstacles in the construction process of the tunnel. The power station will be located at Niyamgamdora at a depth 250m almost below the B412 Highway.

Lot 3 - Hydro Mechanical Works - Contract was awarded on November 29, 2007 to Kurimoto Ltd of Japan

Design and Installation of all hydro-mechanical structures and equipment.

- Spillway Radial Gates, Stop Logs, Trash Racks
- Embedded Tunnel Steel Liners
- Embedded Steel penstock
- Discharge facility for St. Clair's Waterfall

Lot 4 - Electro Mechanical Equipment - Contract was awarded on June 20, 2008 to Mitsubishi Corporation of Japan

Designing, manufacturing, supplying, erecting, training, site testing and commissioning of the following major components for Upper Kotmale hydropower station, Intake dam, Expansion of Kotmale switchyard & Nuwara Eliya Grid Station.

- Design and installation of Turbine, Generator, Power Transformer, Switchyard Equipment, Power Plant Equipment
- Expansion of Kotmale 220 kV Switchyard
- Expansion of 33 kV Nuwara-Eliya Grid Substation
- Flood Forecasting System

Lot 5 - Transmission Line - Contract was awarded on October 06, 2009 to Kinden Corporation of Japan

Design and Construction of 17.5 km length 220 kV double circuit transmission line between Upper Kotmale Switchyard and Kotmale Switchyard.

Many Sri Lankan engineers were actively involved in the design, installation and commissioning of the above works in par with the expatriate specialists, exposing their knowledge, skill and the commitment in executing a very complicated project demanding diverse engineering specialties.

5. The principle features of the Project

Type	Run-of-river type with a regulating pond
Water Level	
Full Supply Level (FSL)	1,194 mmsl
Minimum Operating Level (MOL)	1,190 mmsl
Normal Tail Water Level	703 mmsl
Effective Storage Capacity, Reservoir Area	0.8 MCM, 0.25 km ²
Maximum Plant Discharge	36.9 m ³ /s
Head	
Maximum Gross Head	491 m
Net head at Full Operation	473 m
Installed Capacity	150 MW, (75 MW x 2 units)
Annual Energy	409 GWh
Plant Factor	30%

Details of the Project investments are given below.

Total Project Cost	Million US Dollars 446
Local Investment	Million US Dollars 100 (Taxes, Administrative & Land Acquisition Cost)
Total Loan Amount	Million US Dollars 346
Interest	0.95% per Annum
Grace Period	10 Years

Re-payment Period	30 Years (Excluding Grace period)
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6. Resettlement Action Plan

The Resettlement Action Plan of Upper Kotmale Hydropower Project was prepared by considering the stipulations indicated and emphasized in the National Involuntary Resettlement Policy of Sri Lanka. This policy was introduced to safeguard the affected community by involuntary resettlement involved with project implementation. Upper Kotmale Hydropower Project developed its Resettlement Action Plan with wider public participation at pre-implementation stage and extensive consultation programme was carried out to create awareness of the benefits of the Project to the country and to the affected community.

7. Present Status

The Upper Kotmale Power Plant was successfully commissioned on July 14, 2012 by Excellency Mahinda Rajapaksha, the President of Democratic Socialist Republic of Sri Lanka by adding 150MW capacity to the National Grid. From the commissioning the Upper Kotmale Hydropower Plant, it has produced 720GWh by the end of September 2013 and the production of the Plant has reached to the milestone by producing the expected average annual production 409GWh within 8 ½ months in this year. The outstanding works in the Projects are some construction of facilities for resettlers, preparation works such as drainage improvements, retaining structures, etc. in and around the power plant and reservoir, installation of flood forecast system, etc.