

# Gibe III Hydroelectric Project – a Means to Ensure Sustainable Development

## 1. General

Africa is well-endowed with abundant and wide range of energy resources, particularly with the hydropower. According to Food and Agriculture Organization (FAO) reports, the region has over 1.1 million GWh of exploitable hydropower capacity. In spite of the abundant energy resources, however, Africa's rank of modern energy resources utilization is very limited including the hydropower potentials in comparison with the other continents.

In 2006, the United Nations Environment Program (UNEP) emphasized the key role of hydropower in economic development and environmental protection particularly for Africa since it has intense potential to explore. "The area that has been advancing is hydropower. There's been increasing investment in various countries including Rwanda; and Ethiopia has a major program to increase its hydropower capacity and export it to Kenya. But only about 5 percent of Africa's hydropower potential is exploited", UNEP contends

UNEP has witnessed that Ethiopia is on the way to realize hydropower energy production using the abundant water resources, though not yet satisfied the fast growing energy demand.

During the previous year, power outage was a great challenge for Ethiopia; the every-other-day power rationing has not only affected big factories and export item producing industries, but the national GDP at large. The day-to-day activities of individual live have also been affected. In this regard, people from all levels of the society in part blamed the Ethiopian Electric Power Corporation (EEPCo), though the blames do not stem from the realities on the ground.

Rather, it is very apparent that the power outage has occurred due to the pressing disparity between the level of energy demand and supply; the swift economic episode in the country has insistently pushed the demand for electric energy in a very rapid and unexpected manner. Notwithstanding the phenomenon could not be well substantiated with adequate amount of energy supply instantaneously. (fig.1)

Prior to the recent power outage, EEPCo has also been doing all its level best to bring demand and supply of electric energy into equal level, leaving aside the World Bank experts' assumptions that the Gibe I hydroelectric Project is more than enough to meet the national demand. Despite this, the Corporation has embarked in energy production through construction of other giant hydropower plants such as Tekeze and Gilgel Gibe II Hydroelectric Projects that are particularly in the grid system. Beles is coming in March 2010. Above all these, the Gibe III Hydroelectric Project, the third cascade along the Gibe-Omo basin, is under construction which is expected to make a significant leap in the history of power generation in Ethiopia. All these projects are witnesses of the day to day efforts of EEPCo/government of Ethiopia.

## 2. Basic features of the Gibe III Hydroelectric Project

Situated on the Omo River valley,

about 450kms south of Addis Ababa, in Welayta and Dawro Zones of Southern Nations, Nationalities and People (SNNP) Regional State, Gibe III Hydroelectric Project has officially been commenced in July 2006. It is located some 155 km downstream of the Gilgel Gibe II Powerhouse, operational since September 2009.

Gibe III hydroelectric Project is a fast track project; in 2006, EEPCo has entrusted Salini Costruttori SPA, an Italian construction company, with Engineering, Procurement and Construction (EPC)-type of contract arrangement in which the Contractor is responsible for the engineering design, procurements of works and construction through either its own labor force or by subcontracting part of the work. The total construction of the plant is 1.47 billion Euros, equivalent to Birr 20 billion. EPC contracting arrangement is time and resource saving process compared with the conventional time taking procurement method, which most financiers would like it to maintain. Most of the construction risks are also put further on the EPC contractor. It is the best means of meeting up the fast growing energy demand as it allows fast track modalities.

The quality assurance and design review works for Gibe III Hydroelectric Project is carried out by a joint venture of well known international consultants-ELC Electroconsult of Italy & Coyne et Bellier of France hired by EEPCo as the Employer's Representatives.

The project is best characterized with the following major components:

**Dam:** having a height of 243m, the dam is a classic gravity structure to be constructed using the technology of Roller Compacted Concrete (RCC).

The total volume of the RCC structure is about 5.7 million cubic meters with a crest length and width of 610m and 10m, respectively. Above sea level, the dam has a height of 896 m. (fig.2)

**River Division tunnel:** There are three diversion tunnels-left, central & right-constructed through drill and blast process. The three diversion tunnels, each with 7, 13 & 14 meters diameter and 967, 1,020 & 1,220metres length, respectively, are used to redirect the river water during the construction works. The three tunnels which are already in operation have an average discharge capacity of 5,200m<sup>3</sup>/sec. The Omo River is directed in June 2009 to clear the dam construction area. The River water passes through the tunnels and joins its natural course at a distance of 1km downstream. (fig.3)

**Cofferdams:** the other important elements of the project are the upstream and the downstream cofferdams. The upstream cofferdam, 50m high, and the lower cofferdam are constructed in view of protecting the dam and the powerhouse construction area throughout the construction period. The upstream cofferdam is used to route the flood into the three diversion tunnels and the downstream one in

turn will prevent the back flow of River water towards the construction area. (fig.4)

**Spillway:** this is a structure envisaged for the controlled release of excess floods from the dam to the downstream area. It releases floods so that the water does not overtop the dam and damage or even destroy the dam. In this case, the Gibe III hydroelectric dam is designed for Probable Maximum Flood (PMF) of 18,600m<sup>3</sup>/sec. This release will be accommodated through the spillway structure located in the central part of the dam having by nine bays with radial gates.

**Power House:** The outdoor powerhouse is located on the left bank of the river with the dimensions of 57, 37 & 250meters height, width, and length, respectively. The powerhouse will accommodate 10 generating units with 187MW installed capacity.

**Powerhouse tunnels:** Two power tunnels with 11m diameter each serving five generator units through two steel lined penstocks and manifolds will be used. The two concrete lined surge shafts having 20m diameter and 130m height are also to be installed at the end of each power tunnels. (fig.5)

**Electromechanical Works:** The electro mechanical works of the Gibe III hydroelectric project are characterized by:

Vertical shafts Francis turbines with 187MW each rated output at a maximum net head of 214m.

Vertical axis synchronous generators 220 MVA, 15kV

**Transmission Lines:** The contract agreement for the construction of 50.3km (400kV, double circuit and 3 phase) and 51 km (single circuit, 400kV) for line one and two, respectively, from Gibe III Hydroelectric project switchyard to Wolaita Sodo substation has been signed with TBEA Ltd of China.

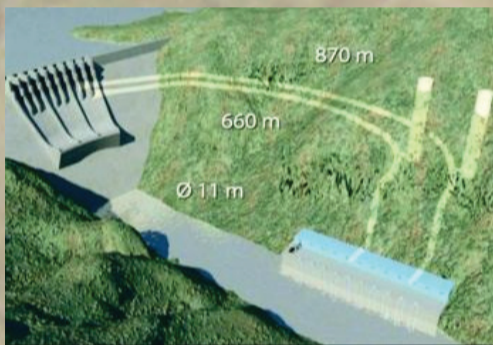
## 3. Benefits of the Gibe III Hydroelectric Project

The Gibe III hydroelectric Project, anticipated to be fully commissioned in July 2013, would enhance the hydropower generation capacity of the country with an installed capacity of 1870 MW and annual energy production of 6,500 GWh. This would in turn be expected to boost the current electric energy of the country (800MW) by 234 percent, implying that the scheme will dramatically increase what the country is producing at present by many folds. (This calculation was made before the Tekeze, Gibe II and Beles hydropower plants have been integrated into the national grid system).

By any standard, the project is said to be the largest, next to the DRC, in the eastern Africa. The addition of such mega energy to the national grid system would enable to guarantee the availability and reliable supply of energy throughout the country. To this end, it will be supporting the



(fig.1. Downstream view of the Dam after completion)



(fig.2. Dam Layout with power tunnels, surge shafts and powerhouse)



(fig.3. The Omo River flow diverted through the three tunnels)



(fig.4. Upstream Cofferdam)

country's Universal Electrification Access Program (UEAP) that targets to increase the country's electric access by 50 percent within few years.

Through the regional interconnection transmission system, the project has also a plan of electrifying the neighboring countries, which most of them are dependent up non-renewable energy resources. Therefore, the project accelerating cross-border electricity trading with the neighboring countries would shift from the expensive and insufficient thermal generation to hydro generation in the regional as well as the international power markets.

Mr. Gilbert Mbeshrubusa, Director in charge of infrastructure in the African Development Bank, witnessed once to the media people is worth quoting here: "The project (Gibe III) will bring electrical energy to Ethiopia, Kenya and neighboring countries, thus contributing to the regional economic development and poverty alleviation."

The project has the following important benefits: improvement of living standards for the surrounding population; small scale irrigation schemes for the downstream community; modern fishing technology; provision of infrastructure like water supply, electricity, roads to the surrounding areas (both upstream and downstream); job opportunities during the construction phase for more than 6,000 people with share goes to the local inhabitants and hence creating about 6 billion Birr market for local businesses.

Furthermore, the Gibe III dam is also believed to positively contribute to the downstream community with regard to flood controlling. The 2006 floods that caused for the death of hundreds of people and thousands of animals and displacement of more than 15,000 populations in the Dasenech area was the case in point.

In addition, the project would help the downstream communities in terms of:

- Reliable and timely water supply for the recession cultivation (prevention of wash-away of cultivations due to sudden and irregular floods)
- Reduction of evaporation losses in the flood plains
- Sustainable flow and positive hydrological balance to Lake Turkana which is characterized by high rate of fluctuations and level reduction at an alarming rate.
- Reduction of extended drought periods.
- Long term sustainable development schemes.

**4. Project Financing**

As far as the project financing is concerned, European investment Bank (EIB), African Development Bank (AfDB) and the Government of Italy (GoI) were requested to finance the hydro- mechanical (HM), the Electro-Mechanical (EM) and part of the civil works, respectively.

On the basis of the requests and confidence in the viability of the project, EIB, AfDB and the Italian Government showed interest to finance the project. Accordingly, AfDB has appraised the project and ready to present it to the Board for approval. Likewise, EIB and GoI are in the process of project appraisal.

On top of this, although EEPCo has done a detailed study on the feasibility of the project, the potential donors have jointly recruited independent

consultants to carry out specific studies on the Project's Economic, Financial and Technical Assessment (EFTA). The study output was presented to the donor groups in a day-long workshop held here in Addis Ababa on October 19, 2009. Evidently, the study result confirms that the Gibe III Hydroelectric Project is viable in economic, financial and technical terms.

**5.Environmental and Social Impact studies of the Project**

EEPCo has cautiously conducted the environmental and social impacts of the Gibe III Hydroelectric Project prior commencement of to implementation. The Environmental and Social Impact Assessment (ESIA) of Project has been prepared in compliance with the Ethiopian ESIA procedures and in accordance with the international standards, as reflected in the policies, safeguard procedures, and guidelines of the African Development Bank, European Investment Bank and the World Bank.

The studies include:

- i) Environmental and social Impact assessment: Dam and Reservoir
- ii) Environmental and Social Impact Assessment: Additional study on Downstream Impact
- iii) Environmental and Social Management Plan
- iv) Resettlement Action Plan (Dam and Reservoir)
- v) Environmental and Social Impact Assessment: Gibe III-Sodo Transmission Line
- vi) Resettlement Action Plan; Gibe III-Sodo Transmission Line
- vii) Environmental and Social Impact Assessment: Chida-Sodo Road Realignment
- Viii) Public Consultation & Disclosure Plan
- iX) Archeological study and mitigation in the Reservoir area

The documents have been reviewed by Environmentalists, sociologists, and other pertinent professionals from EPA, JP Morgan, AfDB, USAID and the World Bank. (fig.6)

Throughout the studies due emphasis has been given for the local communities and the concerned bodies so as to address their concern in the implementation of the project. In this regard, serious of public consultations were initiated in 2006, 2007 and 2008 during the early phase of the project with Federal, Regional, Zonal, Wereda and local officials and institutions, project-affected persons (PAPs), community elders and NGOs. Consequently, more than 1,749 people drawn from administrative and community levels were consulted in which they expressed their positive attitudes towards the project.

In addition, the Gibe III Hydroelectric Project Office has translated ESIA executive summaries to Amharic language and in turn working towards translating the documents into at least seven local languages of the communities living in the upstream and downstream of the project in view of boosting the understanding of the community towards the positive impacts of the project and mitigation measures for the minor negative impacts.

As part of the on-going efforts, EEPCo/ Gibe III Hydroelectric Project Office has also established an independent Environmental and Social Advisory

Panel (ESAP) that would evaluate and provide guidance for the environmental and social concerns of the project. The panel has already finalized paper works to go to the actual duties. (fig.7)

**6. Work Progress of the Project**

Currently, some 35 percent of total construction works of the Gibe III Hydroelectric Project is accomplished.

The Excavation and Lining works for the three diversion tunnels ((left, central &right), are completed and the dry season flow of Omo River is diverted through the center tunnel on January 20, 2009.

The excavation of the Upper and Lower Temporary Access Tunnels (adits) of the power waterways, 37 percent of the excavations of the RCC dam 55 percent of the excavation of the powerhouse are also completed as of the beginning of November 2009 and the wet season flow is diverted through the three tunnels in June 2009.

The construction of the upstream cofferdam is also competed while the downstream is achieved to date about 14 percent. In addition, the construction of the Omo downstream permanent bridge is concluded and opened for traffic since September 2009.

As far as laboratory works is concerned, the RCC trail mix tests on different types and brands of cement are in progress. Based on the results, Pozolana Portland Cement (PPC) is found to be the best type of cement for RCC Dam construction; and hence discussions are initiated with the Mughar Cement Enterprise to obtain PPC in sufficient quantity and quality.

**Summary**

Hydropower has made a tremendous contribution to the society. According to the WB reports, there are about two billion people without modern electricity supply, while two thirds of economically feasible hydropower resources still need to be developed. Hence, developing the hydropower industry is the first and foremost option to back up the sustainable development as well as climate changes Studies indicate that hydropower projects are environmental-friendly alternative energy sources in line with the objectives of reducing the impact of global warming. It is pollution-free, although there can be some disruptions to the social and physical environment. Taking the social, economic and environmental dimensions and potential contribution to achieving sustainable development goals, it is high time to develop hydropower projects that are economically, socially and environmentally sustainable. So, the Gibe III Hydroelectric Project is the case in point within the frameworks of the international standards.

Beyond generating massive electric energy, the Gibe III Hydroelectric Project has multi-dimensional purposes: road access, health stations, schools, pure water and sanitation services were so far rare among the communities at the downstream and upstream areas of the dam. Now thanks to dam construction, infrastructure development activities are being expanded in the surrounding communities. The project is also a hope for the indigenous tribes who used to have a very backward fishery production and cultivation for their mere survival. The project will enable them to use modern system not only for household consumptions but also to supply to larger markets due to emergence of the dam. In all these aspects, Gibe III Hydroelectric Project has a significant contribution for sustainable development.



(fig.5 Model view of the Powerhouse )



(fig.6 Public Consultations and Disclosure at Bele)



(fig.7. Public Consultations with Downstream Communities)