



MONITORING REPORT FOR ZENGAMINA Mini HYDRO SCHEME (GS355)

Yearly Monitoring Report

Project name: Zengamina Mini Hydro Scheme

Period reported: 1st July 2010 to 30th June 2011

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1 Project Description Summary

Zengamina Mini-hydro Scheme (GS355) project is a 700KW project which is located at Kalene Hills, North-Western province at a site known historically as the Zambezi Rapids about 1000 km from the capital city Lusaka with the following coordinates; 11° 07' 26.27"S, 24° 11' 40.76"E. The project proponent is North West Development Trust.

The project which is renewable energy mini-hydroelectric power plant generates electricity which replaces diesel electric plants at the Kalene Hills hospital, Hillwood farm and Sakeji School and provides electricity to previously unserved areas which include schools, clinics and commercial/industrial entities. The project is delivering tangible benefits to sustainable development such as improving access to energy services and increasing of the number of employment in the region.

The project is a run-of-river hydroelectric power plant on river Zambezi (a small river at the location where the project is located) that flows along granite dome, falling about 17meters over about 300 m length of rapids. The fall provided suitable slope which supported the development of a mini hydroelectric project. The rapids were chosen since the river drops 5.4metres over the 300metre distance, and the water pressure “head” is used to operate a small turbine.

The project has the following technical specifications:

- Weir of 1.5m height
- Canal (1.2m deep x 7.5m wide, 350m long)
- Penstock (1.9m diameter x 75m long)
- Tailrace (10.5m wide, water re-enters river at 1.5 m/s)
- Use cross-flow turbine
- 400v/33 kV Step-up Transformer

2 Monitoring Summary

The period of July 1st, 2010 to June 30th, 2011 was a period of very slow growth for the company. Due to a serious lack of funding, there was no capital investment during this period by the *North Western Development Trust* (the company's major shareholder.) Grid expansion was nil and residential connection to the existing grid was minimal (*see ZPL New Contract Chart*). New residential connections did continue throughout the period, but not to any large degree. Though there has been some growth, both in connections and existing customer demand, these increases have not enabled the project to meet, or even come close to, the targets set out in the PDD.

Despite the fact that the project has not been able to meet these targets, the impact of the project has been very beneficial. The electrical power offered by the company has been a catalyst in the first major irrigation project in the area. It has also been fundamental in the planning of various companies considering the processing of agricultural products and provided a much improved way of life for residential customers. The greatest benefit to existing institutional customers is the freedom it has provided from the importation and

stocking of diesel fuels for power generation. Many residential customers now have a reliable source of power that has eased the burden of lighting their homes, powering their communication systems and even providing water in their homes in some cases.

3 Total Electricity Generated

The total power demand of the grid is recorded by an Iskraemeco MT831, 3 phase multifunction meter. This meter measures the power being used on the grid, through three pairs of current and voltage transformers (one on each phase), located in the Hydro substation. This meter complies with the IEC 62952-11, IEC 62053-21 (IEC 61036), IEC 62053-22 (IEC 60687) and IEC 62053-23 (IEC 61268) standards, VDEW demands, and is manufactured in compliance with the ISO 9001 standard. Each day the output of this meter is recorded and the data entered into the company's database at the end of the month.

Metering of the customer connections is accomplished through standard electromechanical single phase or three phase meters. At the end of each month these readings are recorded by ZPL representatives and the data is entered into ZPL's database (and forms the basis of company's billing system).

All metered accounts are recorded this way, but the usage of the non-metered connections cannot be recorded and both metered and non-metered power has been used in calculating the emission reductions by the project for the period.

Over the period of January to June of 2011, recorded customer usage was on average 74.5% of the overall usage on the grid and this shows that around 25% of the power usage is attributed to non-metered accounts.

4 Power consumption trends

Over the course of the period kWhrs consumed by the grid has steadily increased, with the exceptions of October 2010 and the period starting in May 2011 – these peaks are directly related to the irrigation requirements of Nchila Wildlife Reserve.

Connections for the company have risen to 263, - 93.5% of which are residential connections (see excel sheet for monthly connections).

5 Emission Reduction

For the monitored period of 1st July 2010 to 30th June 2011, a total 981,680 kWh of power was consumed from the project. With an emission factor of 0.08 tCO₂/MWh, the project realised emission reduction of 785.34 tCO₂e

$$\begin{aligned}\text{Emission Reductions} &= 981,680 * 0.0008 \\ &\quad (\text{kWh}) \quad (\text{tCO}_2/\text{kWh}) \\ &= \mathbf{785.34 \text{ tCO}_2\text{e}}\end{aligned}$$

Period	ER (tCO₂e)
1 st July 2010 to 31 st December 2010	351.75
1 st January 2010 to 30 th June 2011	433.59
Total	785.34

6 Sedimentation

Due to the small size of the river and the low dry season flow rate, daily inspection of sedimentation was deemed unnecessary. Inspection of the basin above the weir on a random basis has shown that sediment buildup above the weir has occurred to a minor degree, but has stabilised and is not continuing. This buildup is not in the main flow of the river, but off to one side and has not changed over the last two seasons. Sedimentation changes at the bottom of the rapids (below the hydro plant) are unperceivable and not of any concern.

On the 3rd of November 2010, a shutdown of the hydro plant was scheduled for maintenance purposes. During the shutdown the canal and sediment ponds were drained and it was found that there was more sedimentation in the canal than was found during the shutdown in 2009. It was felt that this increased sedimentation in the canal (which is not an environmental problem, but a maintenance concern) was due to leaving one sluice gate in the canal open continually during the dry season, thereby increasing the flow rate in the canal itself.

Higher flow rates would have prevented sedimentation settling in the sediment ponds at the beginning of the canal. However, sedimentation in the area of the weir was not significant, largely due to the company practice of opening all sluice gates during the floods and only closing them when dry season water level drop dictates. This policy has also contributed to the main river channel above the weir being free from sediment buildup, since during the time of major sediment movement (the floods) much of the river's flow is free to pass through the weir almost unobstructed.

7 Reservoir Flushing

The design of this hydro project does not include a reservoir as such. The total land area covered by water as a result of the construction of the weir is about a hectare. Water levels in the river upstream of the weir are slightly affected for some 1,000 meters, but are well below normal historic flood levels. Thus there is little opportunity for sedimentation to occur.

8 Employment numbers

ZPL now employs 11 people on a permanent, fulltime basis and all of them are people living in the area serviced by the project. During the previous monitoring period, the total staff were 10, but there has been an additional staff employed.

The permanent staff are employed as operation managers, linesmen, drivers, plant operators and watchmen. These staff members have been trained on the job for the most part and are able to handle all line erection (both HV and MV) and customer connections. They also man the hydro facility and do all the emergency maintenance on the HV and MV grids. Additionally, the company hires three people on a contractual basis to read meters, deliver statements and collect payments. Part time work is given out to the community for jobs such as the annual clearing of leaves, replacement of poles, road work, meter box fabrication and repair of civil works.

9 Access to Energy Services

Access to energy services is available to anyone that lives within 30 meters of an existing MV feeder line. In some instances there are customers who want power but live too far from a feeder line to make it economical for ZPL to service them.

Due to random location of houses it has proved expensive to provide power to a household located far away from the main grid line. However, the main centre and institutions have been provided with power and also for households who are located within the grid lines or near such centres. Most of the customers are domestic households who account for 93% of the connections.

During this monitoring period, additional households who were able to afford electricity were connected, although the new households were few compared with the previous period. The company managed to achieve 58 new connections during this period (see excel sheet for summary of connections).

SPL are also still signing contracts for connections and as they connect the new customers who have signed them, their households connected will increase further. Up to end of July 2011, the total number of contracts signed has reached 292 and out of these, 263 contracts have been honoured and been connected.

10 Livelihood of the poor in Relation to Poverty Alleviation

The transformation of electrical power into new livelihoods for people has been slow. Some businesses have been started up that are entirely based on electrical power supplied by ZPL, though there are not many such customers. Several companies have shown an interest in bringing milling and pineapple processing units into the area but these are all in the initial evaluation stages. One businessman is in the process of installing sawmill, which, though small, will be a means of improving the economy of the area.



Nchila Wildlife Irrigation



Nchila Mills

Other indirect benefits to the community are related to building projects undertaken due to the fact that the area is now electrified. Kalene Mission hospital has undertaken a large expansion project, building a new theater and intensive care wing. Sakeji Mission School is in the process of building a new kitchen/dining room which will incorporate fully electrified food processing equipment. The government has elected to establish Ikelenge as the seat of a new district and construction is poised to begin on all the government buildings and new housing.



Kalene Mission Hospital Expansion



Pineapple Processing

If one looks at the graph, *ZPL Generation Output – Daily*, they will notice that there is a peak in October 2010 and again starting in May of 2011. These peaks are due to the Nchila Wildlife irrigation program. Nchila is currently running two rain guns to irrigate their dairy pastures and one centre pivot to irrigate 60 hectares of beans, maize and wheat. Wheat has never before been grown in this area. Once the wheat is harvested, it will likely be milled at Nchila and sold locally. This agricultural activity has meant a large amount of money has gone into the community through the employment of people to initiate and maintain these projects. With more access to income by the community, they are able to plan and invest and also send their children to school. All this activities helps in improving their livelihood in the long term as a result of the project.



Wheat Irrigation Programme by Nchila

Impacts of Project to Community

From the above, it is clear that the project has had a lot of impact on the welfare of the community. The most direct impact is provision of electricity for lighting at home. This is quantified based on the total number of its customers who are using electricity for lighting only.

Other benefits associated with the project like extended job creation other than direct employment by the project only depends on investment made in the area by new or existing investors, and this, the project has got no control over.

On poverty alleviation, the project was the key in setting up of wheat irrigation project in the area and with the setting up of the project, an opportunity for paid labour provision was created for the local community. Without the project activity, the irrigating farms will not have been possible, since there is no grid power in the region and irrigating using diesel generators will have been expensive.



Irrigation Schemes



Water Pump



Flour Hummer mill

New business ventures have been set up in the local market which help the investors and at the same time, help the community in access to information and communication. With the right information and communication, the community is able to plan, educate their children and also be informed. These are the factors which go along in helping the community alleviate their poverty and improve their livelihood.



Internet Café



Internet and Telephone communication