Panamanians: Left in the Dark

Hydropower electrical generation for sustainable progress in Piriatí, Panama

International Senior Design 2011 • Department of Civil and Environmental Engineering • Michigan Technological University

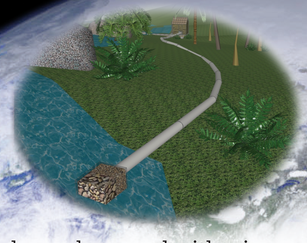
Introduction

Piriatí Emberá is an indigenous community located in Eastern Panamá comprised of approximately **120 homes** and **500 residents.** Currently 50 homes possess limited access (9 hours per week) to electricity produced by a diesel generator, which was installed in 1995. The school and medical clinic do not have access to constant electricity, and **lack technology** and equipment that could help bring the community into the technological age.

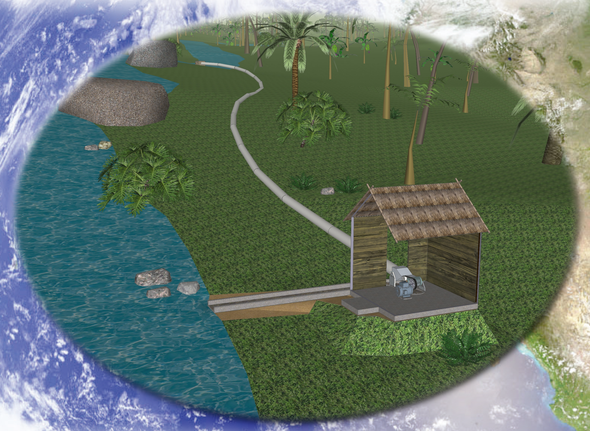
Design Objectives

During an 8 day stay in Piriatí, community surveys were conducted to identify the wants of the community. According to survey data, **community members want electricity for the school and medical clinic.** There is also common interest in owning televisions, irons, refrigerators, and basic lighting to support additional business ventures and educational efforts.

Site Design & Water Intake

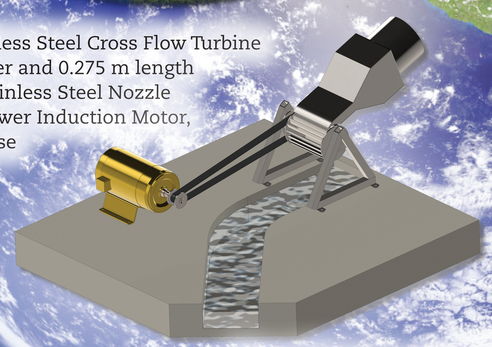


- Inlet filter, rock and gravel encased with wire mesh
- Penstock, 10" diameter shedule 40 PVC pipe
- Flow Rate, 149 liters per second, traveling at 2.9 m/s
- 800 feet of penstock to turbine shelter, sloped at 0.1 m/m



Nozzle, Turbine, & Generator

- Flat Plate Stainless Steel Cross Flow Turbine
- 0.2 m diameter and 0.275 m length
- Flat Plate Stainless Steel Nozzle
- 15 Horsepower Induction Motor, Single Phase



The unit is designed for in-country fabrication, which reduces costs and increases its ability to be customized.

Lighting the Way to Change

Nearly **2 billion** people **worldwide** are currently living **without electricity.**

- Transformer, 460/600 Volts Step Up
- 2 Bundled & Shielded Cables, 0/1 Gauge
- Lighter gauge tie-wire
- Transformer, 600/120 Volts Step Down
- Amp Fuse
- Standard House Wiring

Fuses prevent homes from drawing too much power. Output is 120 Volts, 60 Hz—American & Panamanian standard.

Tie-wires snap first if a tree falls on the lines. They are easily and cheaply replaced.

Transmission & Distribution

Data Collection

Surveying of the river was performed using many instruments and techniques. Flow rates were determined using the float method and river bed profiling. Elevation change, which determines the head of the system, was calculated from transit-stadia surveying using a theodolite. These analyses were used to determine **power potential at 5 sites** along the river; all sites are located less than 10 km from the village.

Discussion

The table below and the central figures represent data and analyses on **Alan's Falls**, a set of 5 drops in the Piriatí River. This is the recommended primary site of electrical generation.

Alan's Falls		
Total Available Head:	22.9 meters	
Estimated Flow Rate:	149 liters per second	
Power Output Potential:	9.9 kiloWatts	
Distance from Community:	6.5 kilometers	
Important Project Units:	**Construction Time:**	**Estimated Cost:**
Foundation, Inlet, & Penstock:	18 days	$3,900
Nozzle & Turbine:	18 days	$2,000
Electrical Components:	123 days	$46,300
Total Project Parameters:	**5 Months**	**$52,200**

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"Cultivating grassroots solutions to bring electrification to developing communities and enrich the well-being of our global neighbors."

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