

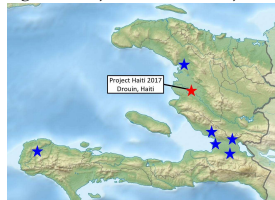
Solar-powered Water Purification and Community Development in Haiti's Artibonite Valley

INTRODUCTION

Since cholera's reemergence in Haiti after the 2010 earthquake, over 798,000 cases have been reported with over 9,440 deaths. Cases have been concentrated in the Artibonite valley where there is no electricity, no modern sanitation, and limited access to health care facilities. The Artibonite River, confirmed to be contaminated with cholera, is the main community water source in this region. The pressing need for reliable, clean drinking water is apparent.

Every year since the 2010 earthquake, ERAU's Project Haiti has partnered with NGOs and local Haitians to design, build and install solar-powered water purifiers throughout Haiti, primarily at orphanages and schools. The cultural integration, effectiveness, and sustainability of the systems have improved with each iteration.

Figure 1: Project Haiti Past Projects



PARTNER SELECTION CRITERIA

In 2017, ERAU Project Haiti partnered with World Renewal International at a school in Drouin, Haiti. The project's most important lessons learned are captured in the Partner Selection Criteria. The Haitian project partner is the most important aspect to a successful project. Prior to committing to a Haitian partner, the candidate organization is evaluated against the following Partner Selection Criteria.

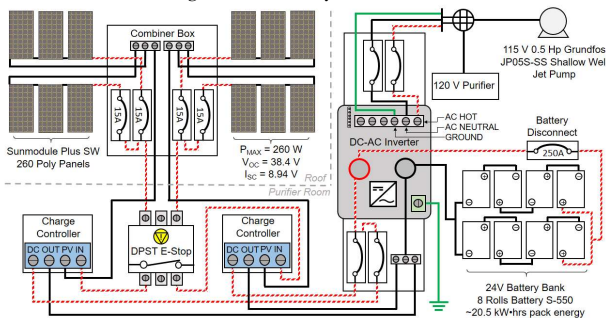
The potential partner shall:

1. Share a compatible mission and vision
2. Participate in cost sharing
3. Control a private well in a secure location
4. Engage in timely and effective communication
5. Have entrepreneurial leadership that understands local culture

ELECTRICAL SYSTEM DESIGN

The electrical power grid in Haiti is unreliable and often entirely absent. Therefore, to reliably power the purifier a solar power system had to be implemented. The purifier uses 1 kW of power, to power it for a 24-hour period, the solar power system must produce 24kW-hrs of energy. With this in mind, a 3.1 kW solar panel array was designed and installed as shown in Figure 2.

Figure 2: Electrical System Schematic



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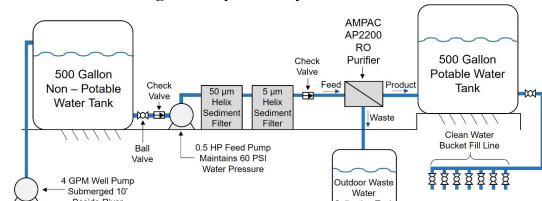
ABSTRACT:

In May 2017, the Project Haiti team of two faculty and eleven students from Embry-Riddle Aeronautical University, Daytona Beach, Florida designed and installed a solar-powered water purification system in the village of Drouin, Artibonite Department, Haiti. This region has been at the epicenter of the post-2010 cholera epidemic that has infected hundreds of thousands and killed many thousands. There has been no reliably safe drinking water in the region. The Haitian operators were empowered with ongoing maintenance and operation of the system, and micro-business operations. Partnership with Haitians and the long-term partnering NGO (non-governmental organization) is a critical enabling aspect that improves sustainability of this community development effort.

HYDRAULIC SYSTEM DESIGN

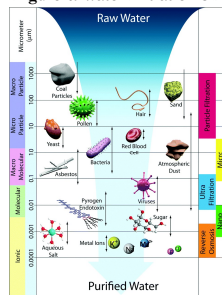
As specified by the partner organization, the hydraulic system was designed to purify at least 1,500 gallons per day while limiting the amount of consumables needed to run the system. Figure 3 shows the three stages of filtration in the Drouin purifier.

Figure 3: Hydraulic System Schematic



1. The first two stage consist of Helix Sediment Filters that remove particles like sand and dirt that are larger than 50 microns (Stage 1) and 5 microns (Stage 2). These filters are ideal as field-serviceable and require no replacement cartridges.
2. The third stage is a reverse osmosis membrane that removes particles larger than 0.0001 microns. As shown in Figure 4, this includes all remaining contaminants (viruses, spores, protozoa, bacteria, and salt).

Figure 4: Water Filtration Sizes



WATER QUALITY TESTING

Microbiological tests were performed on water samples from three locations: Owazis packaged drinking water sold locally, the main community water source (the Artibonite River), and Project Haiti's Cool Blue Water. These sources are shown in Figure 5. Each sample was subjected to three tests indicating the presence or absence of bacteria. Results are shown in Table 1; it was determined that only the Cool Blue Water was safe.

Figure 5: Water Sources Tested



Table 1: Results From Water Tests

Test Performed	Gonaives Cool Blue	Artibonite River	Owazis Local Water
LaMotte Vials	No E. Coli ✓	E. Coli present ✗	E. Coli Present ✗
Hach Whirl Paks	No E. Coli ✓	E. Coli present ✗	E. Coli present ✗
Petri Dish	< 5 colonies present ✓	Multiple colonies, INTC ✗	Multiple colonies, INTC ✗

COMMUNITY HEALTH TRAINING

Those in Drouin and most in the Artibonite region are fully aware of their low water quality but have no other choice. Having access to clean water is vital, but understanding its appropriate use and centrality to basic health is life changing.

MICRO-BUSINESS IMPLEMENTATION

One of the most important elements to the success and sustainability of the project is the launch of a micro-business [shown in Figure 6]. The purified water produced is supplied at no cost to the school, and additional water produced bottled in culturally appropriate bottles and sold at a minimal cost.

Proceeds from sales support:

- System maintenance costs
- Operator salaries
- Teacher salaries
- School costs

Figure 6: Business Storefront and Label



CONCLUSION

The Embry-Riddle Project Haiti team provided:

- **Sustainable Technology and Training** for improved health and quality of life
- **Micro-business** framework supporting education and local economy

The Embry-Riddle Project Haiti team gained:

- Hands-on engineering **experience** solving real issues, with real people, within real constraints
- Global **perspective** and greater appreciation for how critical **education** is to improving quality of life

Figure 7: ERAU Students Distributing Water



Figure 8: Water Before and After Purification

