

Tuesday, March 8, 2005

On Tuesday, we began the day by traveling to the FEDOPO clinic in Guaricano. When we arrived we were unsure of what we were going to do after the wealth of information we received on Monday. Luckily, a local resident named Rico gave us the idea of taking measurements of the cistern, which was still being called the well by some people. He showed us the mechanism by which the water was taken out of the well and into the jet pump that was attached to a pressure tank.



The Jet Pump and Pressure Tank in the Foreground, the Cistern in the Background

We then spent the next hour taking measurements of the cistern, and attempting to find the flow rate of the submersible pump in the well. We also tried to watch for how many times local residents took water out of the cistern, to get a feeling for both community consumption, and as a metric to use later. We thought the possibility of a spigot in place of an open cistern would provide both better water quality, because the cistern would not be exposed, as well as easier access to residents.

The measurements of the cistern we found to be 7 ft. 1 in. in length, 4 ft. 11 in. in width, and 6 ft. 7.9 in. high at maximum capacity. The maximum capacity does not occur at ground level, because there are pipes that take the water and put it back into the ground before the water begins to overflow the top of the cistern. This level is approximately a foot lower than ground level.

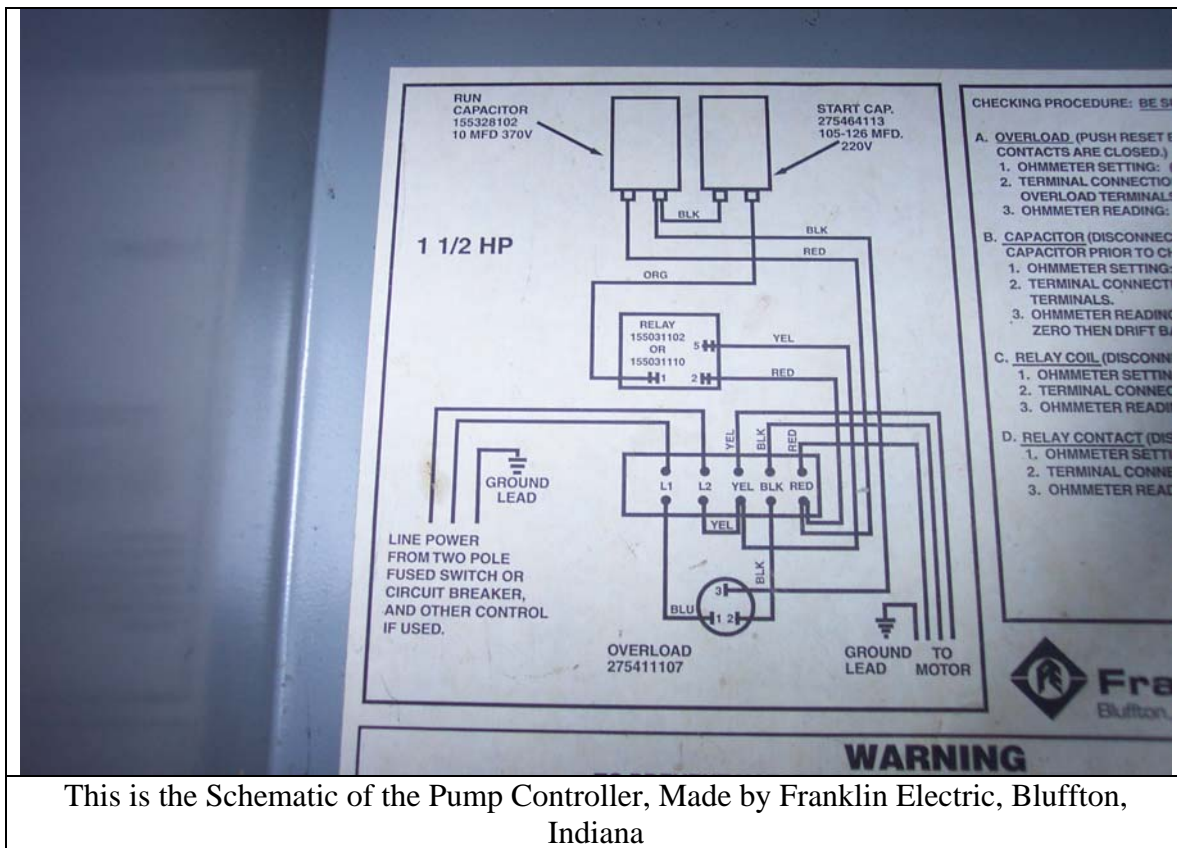
After taking flow rate measurements these were the results we found:

Change in Time	Change in Volume	Volumetric Flow Rate	
5 minutes	287.63 L	57.53 L/min	15.34 gal/min
7.617 minutes	712.79 L	93.58 L/min	24.95 gal/min

As you can see the two flow rate measurements were quite different. We assume that the actual rate is around 20 gal/min. We also noticed that it takes 2 seconds from when you turn on the pump before water comes into the cistern. This may be a way to find the distance from the submersible pump to the cistern.

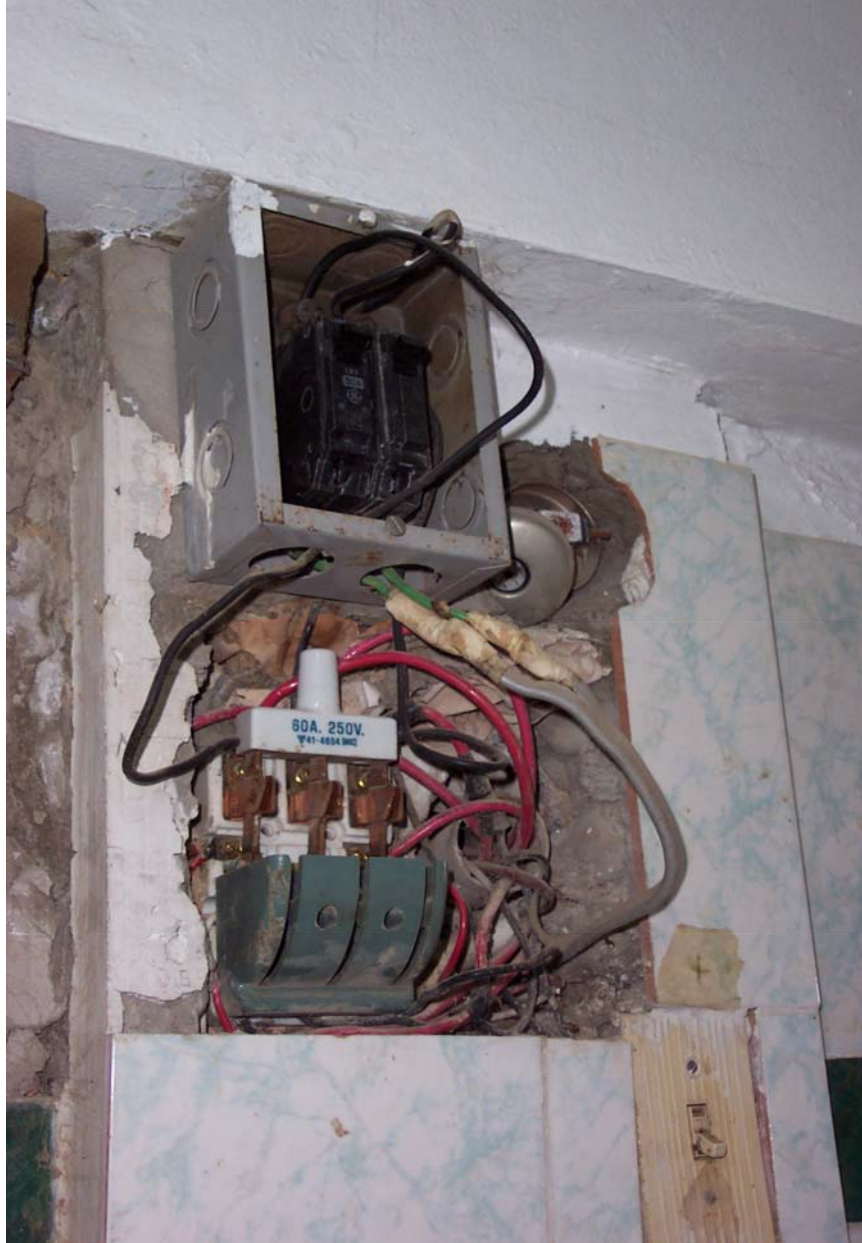
We also learned that the jet pump is currently broken, but still kind of works, it simply leaks a lot of water. When it is on, the pressure in the pressure tank is about 40 psi. Also, we noticed that the pipe connecting the cistern to the jet pump was leaking, and when we informed Juan Carlos, the electrician, he simply went over to it, yanked it out from the connector, put some glue on it, and put it back in. There were about 4 or 5 different pieces of pipe connected between the cistern and the jet pump, which was unnecessary because the pipe was straight.

There are three different controls above the jet pump in the picture above. In the red cage, the breakers to turn on the submersible pump are on the left, and the breakers to turn on the jet pump are on the right. To the left of the red cage is the submersible pump controller, which protects the pump from overheating, and has the starting circuitry for it. The schematic of the submersible pump controller is shown below:



This is the Schematic of the Pump Controller, Made by Franklin Electric, Bluffton, Indiana

We then went inside the clinic with Juan Carlos the electrician we had met on Monday to find the electrical connections of the pumps to the transformer inside the building. The actual connection is inside the building on the left side of the emergency room on the first floor. It has two breakers one is 30 A, and the other is 20 A. There is also a large ceramic switch, we don't know what it is for, but it says 60 A, 250 V on it. This is also the place where the electricity comes into the building. It is then fed around the building to the other side, where the inverter, and batteries are located.



Breakers for Pumps and Where Power Enters Building

After we saw everything related to the pumps, we went to see the inverter and the batteries, which are located on the right side of the pharmacy under the stairs going to the second floor.



Inverter and Batteries

The batteries are all 6 V, 225 Amp-Hour batteries, which require maintenance. It seems that in the DR, you cannot purchase gel, sealed batteries for some reason. This may be because of the temperature or humidity, but we think it is simply because the country is not as technologically advanced as ours is. The inverter is a single-phase inverter and is plugged directly into the lines coming from the pump breakers on the other side of the building. The blue switch that is at the top of the picture is a manual switch between power from the grid and power from the batteries. The power from the grid is on between the hours of 8:30 am to 4:30 pm. After this the batteries must be used, along with the diesel generator, which is currently broken. Unfortunately, the clinic's power needs require the batteries to be discharged to 20% capacity, which makes the clinic have to replace the batteries every 6 months. Each battery costs approximately \$80 US, which means that they have an annual cost of \$640 or 17,920 pesos for the batteries, which is a lot of money to them. Simply replacing the batteries with sealed batteries, and a larger number of them would save them money. The box with all the wires in it contains the breakers for the first floor, and the breakers next to it are for the inverters.

Electrical Priorities

After we had finished looking at these various electrical components, we had Jeanese, one of the doctor's in the clinic take us on a tour, and show us everything that needed to on at night. She was also unaware that the generator which we had looked at the previous day was not functioning, until Juan Carlos told her. In reality, there was not all that much that needed to be powered at night, besides the light in the emergency room

and the refrigerator in the lab. These were the two most important and necessary items. She also showed us everything else that needed powering the clinic, including other lights, a television, an ultrasound, etc. Another interesting note was that because the electrical systems on the first and second floor were not connected, the second floor has no power at night, and is not attached to the inverter. If we changed this, that would be another metric, because it would allow FEDOPO to possibly have classes, or playtime for kids at night, it would only require a few lights.

During the tour we noticed that most of the lights on the first floor were incandescent. We asked why they did not use compact fluorescent, and they informed us that often times there would be large electric surges that would burn out the light bulbs. Because of this, it was becoming too expensive to continually replace the bulbs, so they just used incandescent. Also, in some rooms, they would only put lights in the sockets when the light was needed, so they would not chance it burning out. We also tested the quality of the power in the clinic, and found it to be quite dirty. Ironically, this would be demonstrated the next day, when we were using computer speakers in the clinic, and noticed that the sound quality was worse than when we had used them at the hotel. Luckily we had brought a surge protector, because we also experienced a surge. After which the speakers seemed to work a lot better. We think that what must have happened was the dirty power was leading up to a surge, which then brought the power back to a cleaner state.

Ferreteria Americana

After we were done with this we traveled to the Ferreteria Americana with Juan Carlos, the electrician, and Jose Luis, one of William's assistants. The ferreteria Americana is the Dominican version of home depot. Except it is about twice as big. They were selling a 250 kW generator to the general public, that looked like the wind tunnel generator in Glennan, it was crazy. When we went in they took Dan's video camera away, because apparently you're not allowed to take pictures of anything. But we are prepared student engineers, and had my digital camera, and Dan's palm pilot in our pockets. So we were not yet without hope. Juan Carlos took us on a tour of the store, and we had two of the Spanish students who are both biomedical engineering majors as well as translators. He showed us a lot of different things, and explained to us that he used pvc pipe instead of copper because it could handle higher temperatures. He also showed us the submersible pump that is used in the well. When we had talked to Juan Carlos about the tank on top of the clinic, they had been referring to it as a tinoca, which is not the Spanish word for tank. We realized at the store, that tinoca was part of a brand name of tanks. We found one of the tanks, and it was around \$100 for 265 Gallons of capacity. The tank that is currently on the roof holds about twice as much as that but it is not covered, and as you could see from the pictures from Monday, a lot of outside contamination can get into the water. However, the loss in capacity would be made up for by the fact that the PLC controller would be continually filling the tank, so that when the grid shut off, the tank would be full.



Unfortunately, this picture had to be taken secretly and is not very good. Basically the pump is made by Myers Pumps in Ashland, Ohio, and is a 1 HP single phase pump, called the Predator

We also had another frightening experience, when Dan decided in an effort to prove me wrong he would pick up the caps to one of the deep cycle batteries which we had seen at the peace core, to demonstrate that it was in fact not maintenance free. From working in a battery shop, one would think Dan would have thought about what he was

doing, but no, instead he splattered battery acid on his hand. At first it did not hurt, but soon he was seen running towards the nearest bathroom, which was at the opposite end and 2nd floor of the building. We also purchased electrical socket covers to put over the open wires that we had noticed at the clinic earlier in the day.