



Technical Report

Ranger Class

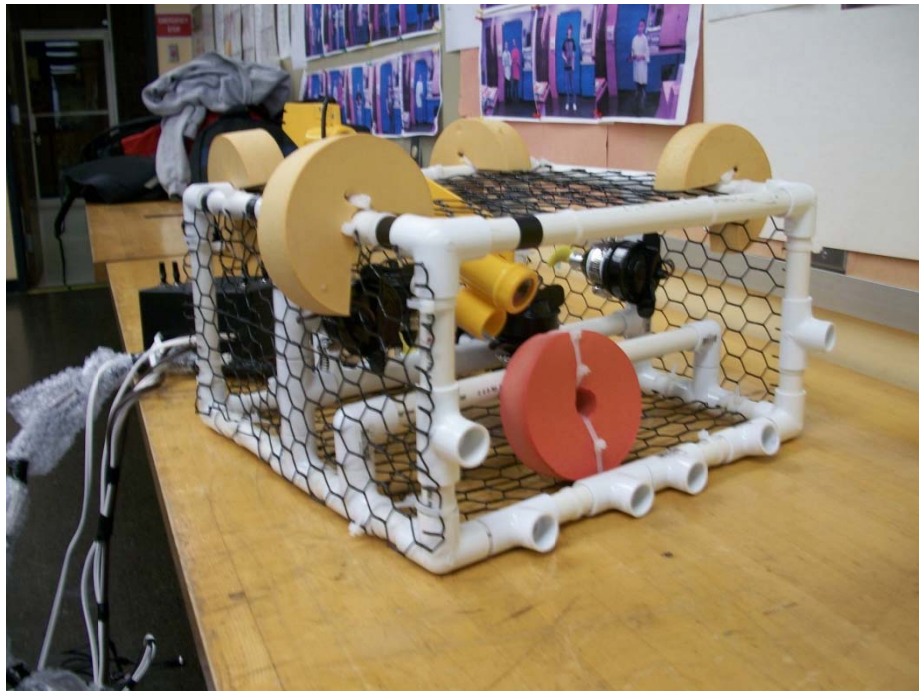
Submitted by

Team **NB Whalers 1**

New Bedford High School



The Whale



Team NB Whalers 1 members:

Jack Daly, Tyler Arena, Joshua Goncalves, Blaine Hopwood Jr.

Instructor:

Christopher Parker

Table of Contents

<u>Page</u>	<u>Content</u>
1	Cover Page
2	Table of Context
3	Abstract/Team Information
4	Team Information
5	Design and control system
6	Video Camera
7	Wiring/Motors
8	Tools used
9	Mission 1
10	Mission 2
11	Mission 3
12	Mission 4
13	Troubleshooting
14	Challenges Faced/Lessons Learned/Future Improvements
15	Living in New Bedford
16	Acknowledgements
17	Parts log
18	Electrical Schematic
19	Loihi Seamount



Abstract

The ROV that our team created in these four months has presented many problems and challenges to surpass. We welcomed these with open arms because we knew overcoming these obstacles would only make our team and “The Whale” a stronger contender. The gains we have had since our first design process are remarkable. Our ROV “The Whale” was created in our school, New Bedford High School, by Team NBHS1. We have worked diligently over the last few months to generate attachments, as we call them, to accurately perform the four tasks at hand. The tasks seemed difficult at first, but through weeks of brain storming and design rationale, we finally created a ROV that we felt had the ability to successfully perform these tasks.

“The Whale”, which will be piloted by team member Josh Goncalves, was made on the basis of simplicity. This being our first ROV and our first year entering the competition we didn’t want to bite off more than we could chew. PVC pipe was our go to material because we wanted to stay under budget but also wanted an efficient source for construction. We built our own control box from scratch, which is attached to our ROV via the tether. It’s controlled through the use of momentary switches in directions such as forward and reverse, side to side, and up and down. Our motors, along with the whole ROV itself, are covered in lobster pot wire. Safety was a big concern in our designing and building.

Team Information

Our oldest member and mentor, Mr. Parker, has been teaching technology for twenty years and his knowledge of wiring and construction has taught able to build this or even have any supplies.



One of the seniors, Josh Goncalves knows a great deal about cars and engineering which helped us in building the main frame of the ROV. He always wanted to get it started and finished and his many ideas on how to attach the motors and where the motors should go helped the team make the first decisions.



Our second senior Blaine Hopwood Jr. was a great asset in building the tether and doing the wiring of the project. We had to take our frame apart many times and he was always the person to do it. He was the key person who made the tether and always would work using the power tools.



The first freshman, Tyler Arena, cut the PVC in the beginning and measured them perfectly. He also was Blaine's assistant in making the tether. He soldered most of the wires and assisted in pulling the wires through the holes in the PVC pipe. He also wrote the outline for team NBHS 1's report and helped in making the control system.

Our other freshman, Jack R. Daly, was the person who wrote most of the report and did all of the budget sheets and measurement sheets. He also helped making the PVC T's to hold the motors in place and built the aluminum hooks for task one. Everyone did a great job on this project and together we all contributed a main piece to it.

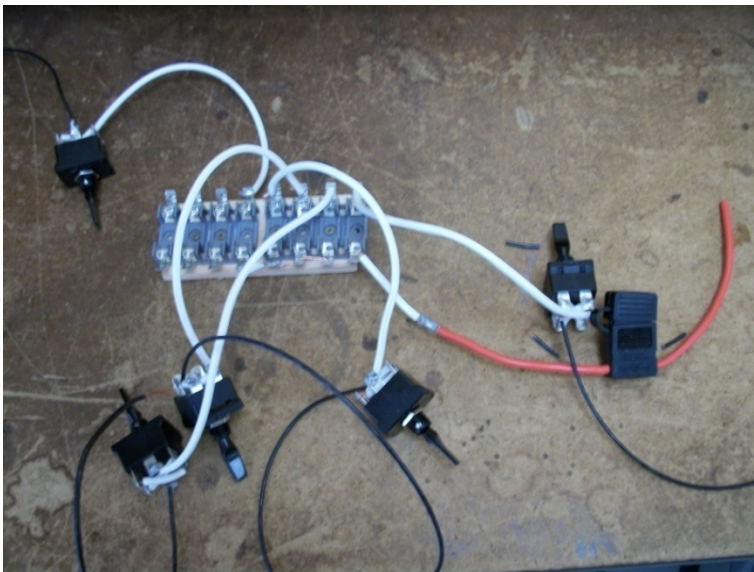


Most of our supplies were provided by the New Bedford school system but some simple supplies were provided by the team members themselves. We adapted our resources to develop a product that will work as well as more expensive equipment. We worked in our technology classroom in New Bedford High School. We also were able to use the tools in the wood shop and the automobile shop. This is our teams first year doing this competition so we might not

have as much experience, but through debating and problem solving we came up with a just as good, maybe even better project.

Design

Frame: The Frame of the structure is constructed of 1.27cm PVC pipe. We used PVC pipe because it was easy to cut into any shape that we wanted and it was light weight. We also have our wires running through the pipe as a safety precaution. This is to make it less congested and more user friendly. With the PVC pipe we have the opportunity to take it apart without damaging the pipe. We also drilled holes in the pipe in order for water to enter and flow out.



Control System: Our control system has five momentary switches. We had one for each motor. The five switches were screwed into a plastic black project enclosure.



Video Camera: The video camera of the ROV is a 5.5" Underwater Video System, model ISO9001-2000. It is a high resolution black & white video camera and monitor system. It has a 20 meter cable and a 12 V CD rechargeable battery. It has controlled infrared lights that you can turn on and off. It is the ideal video camera because it works great with every task. We used two of them, one in the front to see things close up and one in the back with some height so we could see everything in front of us.

Wiring: To wire the ROV we had to make sure every wire was sealed so no water could get in and that all the wires could come together in one tether. Each motor has a separate wire



that has electrical tape on it and every wire is soldered to prevent a short circuit. The wires run through the hollow PVC pipe and come out one hole in the back. The tether is 20 meters long and it connects to all of the wires that come out of the PVC.

Motors: The motors we used were the Johnson Pump motor model 2857. It is ten centimeters long and eight centimeters wide.



Safety: When designing “The Whale” one of our main goals was safety first; rather than enclose each motor individually, we decided to enclose our whole ROV all together. To do this we used lobster pot-wire which not only enclosed our ROV but it also securely held the PVC pipes together. This design allows safety to a diver or student who would pull it out of the water with the motors still running.

Tools Used: Hacksaw, Power Drill, Ratcheting PVC Pipe Cutter, Hammer, Spindle Sander, Band Saw, Table Saw, and a Solder Iron.



Mission 1: *Remove pins to release HRH from elevator.*

- *Place the HRH in a .05m by .05m square at the site that is rumbling.*
- *Remove the cap from the port on the HRH junction box.*
- *Retrieving the HRH power/communications connector from its holder on the elevator.*
- *Inserting the HRH power/communications connector into the port on the HUGO junction box.*
- *Identify one of the three sites that are rumbling*

How we did it: To remove the pins to release the elevator, we had to think of something that could grab it from two angles. We used two aluminum rods for each hook. We stuck the rods into a wooden dowel. We stuck the two rods in one dowel by having them create a 90 degree angle so it could grab the pins from two angles. Then we stuck the wooden dowels into open PVC pipe. We used J. B. Welds to glue the wooden dowels into the PVC pipe. This would be able to pull out the pin and lift up the Hydro foam. To identify the rumbling sight we used a speaker/amplifier to identify which site was rumbling. This is how we completed task one.



Mission 2: *Collect samples of a new species of crustacean*

How we did it: To collect the samples of a new species of crustacean, we had to create something that could grab them from the wall as well as the floor. We created a metal frame like a lobster cage and then lined it with a yellow net. We chose this certain net because it wouldn't create too much drag and it would still hold in the crustacean. We had to different designs for the net. The first design that was unsuccessful because it was too large was just half a rectangular box made of the same material. It has sides that stuck out so if there were crustaceans on the wall it could knock them off. The second cage design is a cylinder looking cage that is cut in half. It has a hole in the back in which leads to a net. The net makes a pocket and when not in water is a pocket. When put into the water with the ROV moving the water pushes the pocket up so the crustaceans can be put into it. When it returns to the surface the crustaceans will safely be inside of the net.

Before



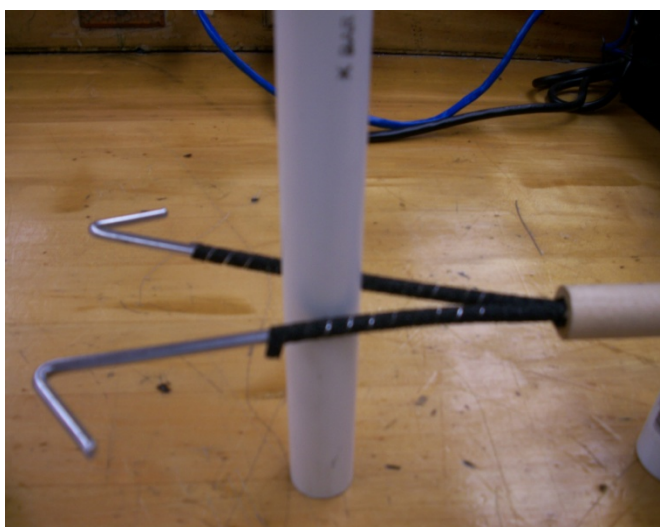
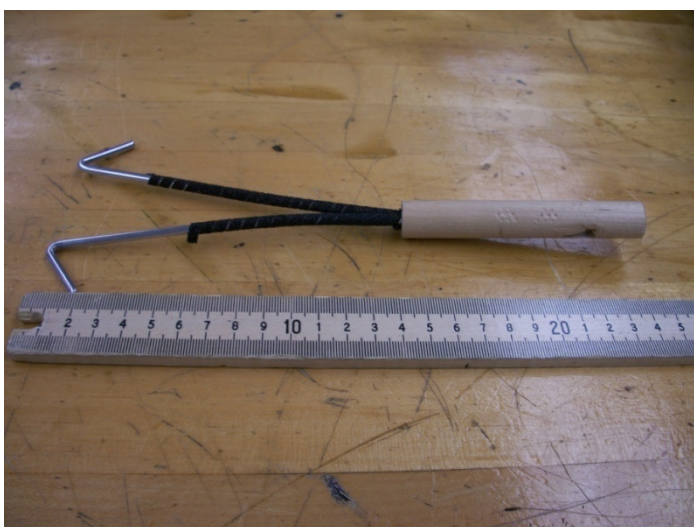
After



Mission 3: *Measure the temperature of the venting fluid at three different locations along the height of the chimney.*

-Collecting a sample of a vent spire.

How we did it: Collecting the sample of a vent spire was a difficult task. We had to figure out a way to pick it up without using another motor because we did not want to add weight. We came across as having to go into it and pulling it up until our mentor came up with an idea to come from the outside. We took aluminum rods that were bent at the top. We stuck them into a wooden dowel and angled them away from each other. Then we wrapped the rods with non-skid tape so it would be more stable. The idea is to ram it right at the vent we choose, so it gets stuck between the aluminum rods.



Collecting the temperature of the fluid was also difficult. We had one camera to be able to read the digital thermometer. The problem was we didn't know if we would be able to read in the dark cavern so we had to get a camera with LED. We chose an underwater LED camera with a 20 meter tether. We received a thermometer from an administrator from our school. We assembled a wooden dowel around it onto the ROV so it would be stable. This is how we completed task three.



Mission 4: *Collecting a sample of a bacterial mat.*

How we did it: We collected the sample of the bacterial mat by using a piece of PVC pipe that was cut at an angle. It had a hole in the bottom of it with a net that made a pocket. The sample can go directly into the pocket and be transported back to the top of the pool. The more sample we collect the more points we obtain. The numbers below show how many points we get.

< 25mL – 5 points

25mL to 100mL – 10 points

101mL to 175mL – 20 points

176mL to 225mL – 10 points

>225mL – 5 points



Troubleshooting:

In our ROV the NB Whaler 1 we faced problems as we tried to execute our design. The first problem we faced was designing a net that could accomplish task two, retrieving crustaceans from the bottom of the pool. Our plan was to use a modified lobster trap, leaving the top as well as the front open to be able to scrape the wall and floor to pick up crustaceans. By examining task two, we realized the crustaceans were small enough to go through the square holes of the lobster trap, so we decided on enclosing the lobster trap in netting. Our first net was similar to the ones you find when you buy a bag of potatoes. After installing this net it became clear that the net would not accomplish the task. The net was too flimsy and created drag because of its small holes. So we took the net off and went back to the drawing board. We sat there looking at the task and what the net had to do without slowing down our ROV. We decided with a plastic mesh net that had bigger holes and was a lot more rigid.

Our second problem was where to place our cameras to be able to accomplish all our tasks. Originally we had an idea to place the cameras toward the back of the ROV, but this plan was changed when we installed the motors. We realized when the motors were going they would turn up the water, blocking the view of the cameras. So we came up with an idea to place one camera in the back above the motors to get a view of the whole ROV and a motor down lower in front of the motors to view the tools when doing the tasks.

The third problem we faced was getting the motors to go forward when the switches were pushed forward and backward when the switches were pushed backward. For the switches that did not operate correctly it was a simple fix. All we did was unscrewed the switch and flipped it around so that when you pushed the switch forward the motor went forward.

For every problem we faced we went back to the drawing board. We wrote down ideas to solve the problems and then decided which idea was best and implemented it. Sometimes it was an easy fix, for example, the switches were simple as to what could be done to solve the problem. Other times it took looking at each task and drawing new ideas (for example the net). In the end we were able to come up with a solution to every problem we had.

Challenges Faced:

We had many challenges to face since we are just a first year team. Our team consists of two freshman and two seniors in high school. Most of the team had no experience with building an underwater ROV and we found out about the competition about five months before it started. The most frequent challenge that we had was disagreement among team members. Everyone had different opinions and was convinced of their position.

Besides that challenge, our materials took a while to come so we couldn't start for a while. They came in the first week of March and that was difficult because it took a while to get building. We didn't even get our camera until April which was very difficult because we needed it so we would know where our vision would be.

The wiring of the project wasn't impossible but we had our troubles. It was difficult to make sure the wires weren't exposed to the water since we didn't have anything to protect the wires; we had to do a lot of soldering. Also we had to wrap them with electrical tape. The camera was also challenging. We planned to use two cameras but the second camera we got did not connect to the monitor and wasn't water proof. So we bought two of the same camera. Even though the waterproof cameras did not have as good a resolution, they were lighter and easier to use. These cameras also had LED lights on them so the conflict was solved.

One of the greatest challenges was how to attach the motors with the least amount of weight. We used a PVC T and then used a spindle saw to make a curve into it. The motors fit right into the curve of the T and then we used hose clamps to secure it into place.

Lessons Learned: We have learned a lot of useful information while building this project. We learned many tasks in building this project. We learned how to research together, how to do metric conversions, how to build and construct, and how to work together as a team. Some of the tasks that we did learn were how to solder, drill, wire and design a plan. Electrical wiring was also taught to us by our mentor. Hydrophone was also a difficult task that we needed to understand. This experience has been very good for the group because we learned some tasks that could help us in life and gave us an introduction to engineering.

Future Improvements: Next year when we participate again one of the main things we would need to improve was our starting time. The late start for our team which was the first week of March made it harder to improve the ROV and perfect it. The parts would need to be ordered earlier and we would need to focus on each task we had to do one at a time. We would also want to try to make the ROV lighter. We used so many materials that weighed down the ROV and made it slower. In the future we would also add a fifth team member to lessen the work load for each individual. An extra worker would help because we would always be multi-

tasking and rushing through our tasks. In the end an early start would have solved most of the problems and made it easier on the workload.

Living in New Bedford:

New Bedford is an ocean side city. It has a harbor and possesses a rich whaling history. By living here for our whole lives we have become used to the design of the fishing boats and how things work in water. Living in this city provides you with plenty of background information on how to make a vehicle for the water.

New Bedford has many oceanic scientists. Our school system also has its own marine education summer program, Sea Lab. One of our team members attended Sea Lab for six summers. In this program he made an ROV himself which was useful for this project. Although the one he made was more primitive, he at least knew some of the basics.

This city may have snowy winters, but it also has warm summers that include many opportunities to go to the beach. By being able to go to the beach at least once a week in the summer, we have learned by ourselves certain simple aquatic facts and observations that are necessary for building a ROV like this.

Living in this famous fishing city we have used devices that fishermen use on their boats on our ROV to complete the tasks, such as a net to catch the new species of crustacean. Our net idea came up after thinking of the fishing boats that trawl their nets on the ocean floor. The next idea that came from the fishing industry, was to use hooks with two sides to pull out the pin in task one. This would give us more of a chance to catch the pin, just like it would give a fisherman more of a chance to catch the fish.



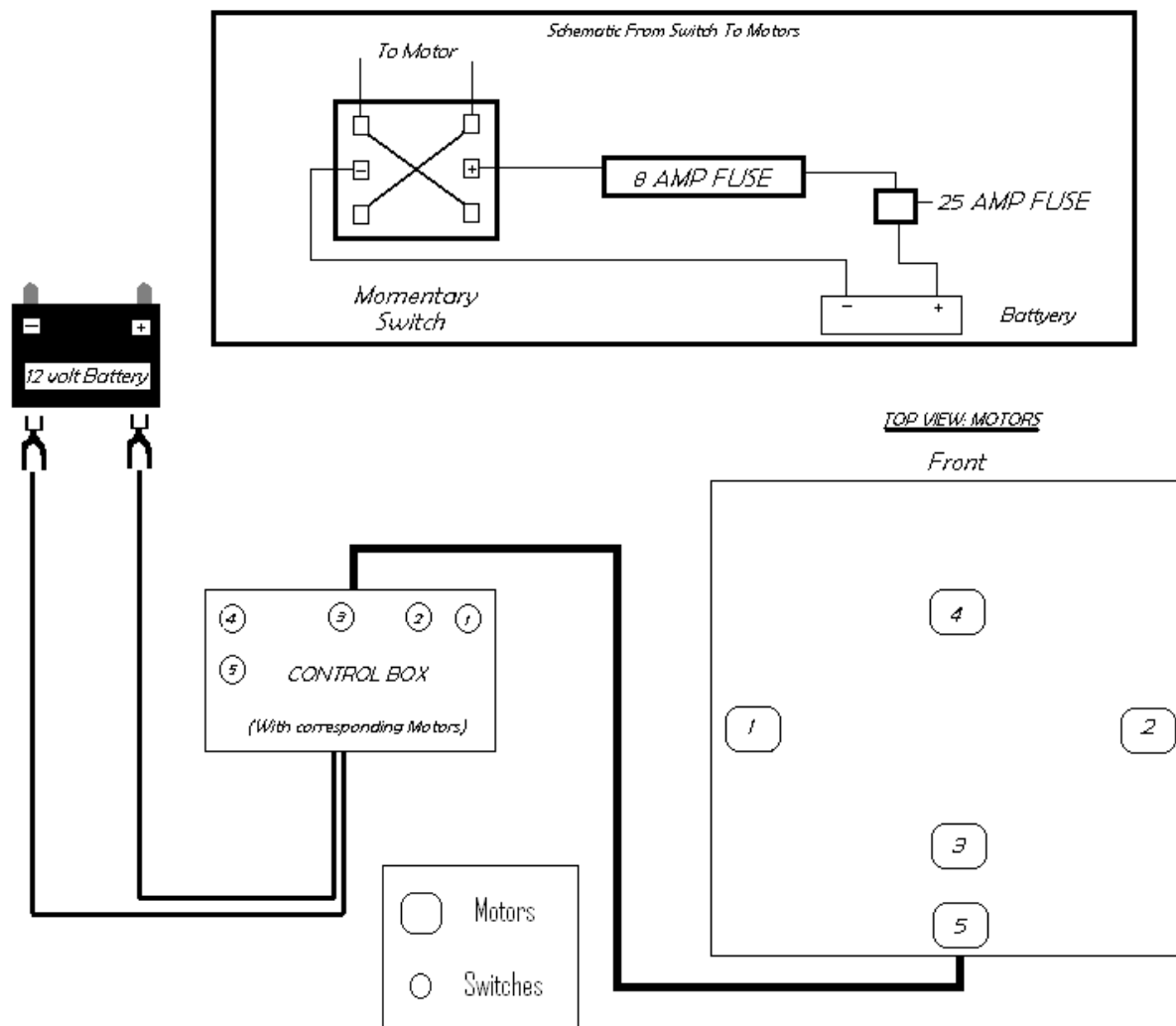
Acknowledgements

- MATE: The MATE center provided us with all of the information that we needed to compete.
- NewBedford High School: New Bedford High School provided us with the facilities to construct our ROV and machines that we needed to build it.
- Ketcham Traps: Ketcham Traps provided us with lobster-pot wire, poly floats and electrical tape.
- Mahoney's Building supply: Mahoney's Building supply provided us with lamp wire, PVC pipe, pipe ratcheting cutters, hose clamps and zip ties.
- Radio Shack: Radio Shack provided us with a condensor microphone, audio cable, Mono phone plug, mini audio amplifier/speaker, electrical tape, battery holder, conductor phone cable, 9V battery, multi-color heat-shrink tubing.
- Happy Hobby: Happy Hobby provided us with left and right propellers and propeller adaptor kit.
- Supercircuits: We were given our underwater camera system by Supercircuits.
- Cabela's: Cabela's gave us Mayfair Cartridge Replacement Motors 750 GPH

Parts Log

<u>Item</u>	<u>Quantity</u>	<u>Unit Price</u>	<u>Total Price</u>	<u>Vendor</u>
Under Water Camera System	2	\$139.95	\$279.90	Supercircuits
DPDT Momentary Flip Switch	5	\$4.49	\$22.45	Radio Shack
4-Position Fuse Block	2	\$3.29	\$6.58	Radio Shack
Slow-Blow 1 1/4"x1/4" Glass Fuse-8.0A 250V	2	\$2.39	\$4.78	Radio Shack
Inline "Blade" Fuse Holder	1	\$2.59	\$2.59	Radio Shack
25 Amp Blade- Type Automotive Fuse	1	\$1.49	\$1.49	Radio Shack
30-Amp Car Battery Clips	2	\$3.69	\$7.38	Radio Shack
6x4x2" Project Enclosure	1	\$4.99	\$4.99	Radio Shack
Mayfair Cartridge Replacement Motors 750 GPH	5	\$17.99	\$89.95	Cabela's
1/2" PVC Side Outlet EII Soc Fitting	8	\$1.56	\$12.48	Mahoney's
1/2" PVC Snap-On Saddle IPS O.D. x Soc Fit	8	\$0.64	\$5.12	Mahoney's
1/2 PVC Pipe 10' length	2	\$2.25	\$4.50	Mahoney's
1/2" PVC Te Soc Fitting	14	\$0.35	\$4.90	Mahoney's
1/2" PVC 90° EII Soc Fitting	2	\$0.30	\$0.60	Mahoney's
#12 SS Hose Clamps 11/16" - 1 1/4"	1 Pkg.	\$12.50	\$12.50	Mahoney's
8" Zip-Ties	1 Pkg.	\$29.95	\$29.95	Mahoney's
250' Roll SPT 2, 16 Gauge, Lamp Cord White	1 Roll	\$60.00	\$60.00	Mahoney's
250' Roll SPT 2, 16 Gauge, Lamp Cord Brown	1 Roll	\$60.00	\$60.00	Mahoney's
1" Plastic Pipe Ratchet Cutter	2	\$16.99	\$84.95	Mahoney's
Condenser Microphone	1	\$3.79	\$3.79	Radio Shack
Audio Cable 2 Conductors Plus Shield 100'	1	\$9.89	\$9.89	Radio Shack
Two Conductor, 1/8" Mono Phone Plug	2	\$2.69	\$5.38	Radio Shack
Mini Audio Amplifier/ Speaker	1	\$14.99	\$14.99	Radio Shack
Black Rubber Electrical Tape (Not PVC Tape)	3	\$3.99	\$11.97	Radio Shack
Battery Holder (Fits One "C" Cell)	1	\$0.99	\$0.99	Radio Shack
Battery 9V Model: U9VLBP-RS	1	\$9.99	\$9.99	Radio Shack
100ft. 4-Conductor Phone Cable	1	\$13.99	\$13.99	Radio Shack
Multicolor Heat-Shrink Tubing (12 Pack)	1	\$3.99	\$3.99	Radio Shack
Octura Plastic Prop (L)	1	\$1.25	\$1.25	Happy Hobby
Octura Plastic Prop (R)	4	\$1.25	\$5.00	Happy Hobby
Prop Adapter Kit	5	\$4.99	\$24.95	Happy Hobby
Lobster-Pot Wire	1m ²	\$6.99	\$6.99	Ketcham Traps
Poly-Floats	5	\$1.00	\$5.00	Ketcham Traps
Electrical Tape/Bubble Wrap	2/2	\$5.00	\$10.00	Ketcham Traps
<u>Totals</u>		<u>\$450.20</u>	<u>\$823.28</u>	

Electrical Schematic



*** Switches are numbered to match the motor they control.**

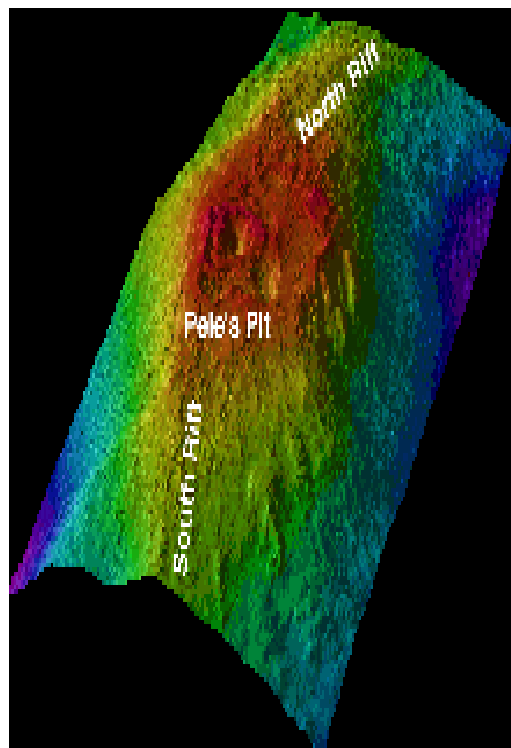
Loihi Seamount

The Loihi Seamount is the youngest volcano in the Hawaiian Islands. It was considered a Seamount until its first eruption in 1996. It has now been active ever since. It is on the south-eastern side of the big island of Hawaii. It is under the Pacific Ocean. The Loihi is surrounded by two large volcanoes that are over 80 million years old. Loihi is constantly spewing hot lava that hardens in the water and becomes rock. This “volcano” shows no threat now because it is underwater and the most drastic thing it could do is create another piece of land. The lava would not endanger anyone because it is submerged, but this seamount does threaten the Islands with earthquakes. When the volcano erupts it causes earthquakes. If it had a large eruption then it could cause a very dangerous earthquake that could even cause a tsunami. This Seamount/Volcano is very interesting because it has only been a volcano for a few years while many volcanoes have been around for millions of years.



To the left,
lava from
Loihi forms
into rock.

To the right is
a diagram of
the Loihi
Seamount.



Sources:

Rubin, Ken. "General information About Loihi." *Hawaiian Center for Volcanology* . N.p., Jan. 19 2006. Web. 5 Apr 2010. <<http://www.soest.hawaii.edu/GG/HCV/loihi.html>>.

MArine Advanced Technology Edjucation Center. N.p., n.d. Web. 25 May 2010. <<http://www.marinetech.org/>>.