CYLON CORP.
COLEGIO SAGRADO CORAZÓN DE JESÚS
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PONCE, PUERTO RICO 00716-3836

PROPOSAL FOR THE PORT OF LONG BEACH TRANSFORMATION PROJECT PORT CITIES OF THE FUTURE: COMMERCE, ENTERTAINMENT, HEALTH AND SAFETY

COMPANY TECHNICAL DOCUMENTATION

COMPANY MEMBERS	ROLES	E.G.D.
Carlos Ocasio	CEO, Pilot	2017
Bianca Rodriguez	COO, First Co-Pilot	2020
Veronica Melendez	CFO, Project Manager	2018
Luis Hernandez	Tether man	2018
Eduardo Aponte	Second Co-Pilot	2017
Andrea Santiago	Safety Officer	2020
Geraldo Lebron Jr.	Research and Development	2023
Jan Michael Lebron	Research and Development	2022
Ricardo Goitia	ROV Technician	2018
Alaina Roman	System Designer	2020
Geraldo Lebron Sr.	Science Teacher	
Armando Rodriguez	Mentor	
Raul Santiago	Assistant Mentor	
Aymette Medina	MATE Regional Coordinator	

ABSTRACT

The MATE Center and the Port of Long Beach have issued a Request for Proposals soliciting bids from potential companies qualified to undertake a series of marine construction, maintenance, surveying and environmental cleanup activities pursuing the transformation of the Port of Long Beach. Said transformation is aimed to make the Port of Long Beach become a beacon in the commerce, entertainment, health and safety areas of the marine port world.

CYLON Corp. was founded on 2017, by a group of Puerto Rico's most talented engineers who joined forces with the purpose of developing the most efficient ROV to execute the tasks required by the MATE Center and the Port of Long Beach to help them achieve their goals. As a result, CYLON has develop and proposes the use of its Underwater Vehicle for Exploration or as we call it, UVE, for undertaking this endeavor. UVE is a small, light, fast and efficient ROV capable of entering small places, carrrying heavy loads with gracious movement and great speed. It has two 2.7 A motors for horizontal movement and two more for vertical movement. Has a 360° rotational frontal claw that is operated hydraulically. Two cameras allow it to see forward and downward and a LED light used to locate possible underwater contaminants.

Please find on the next pages our company and ROV technical documentation for your evaluation. We are grateful for your consideration and confident that you will find UVE and our personnel to be a great match for this project.

CYLON, Corp. Company members

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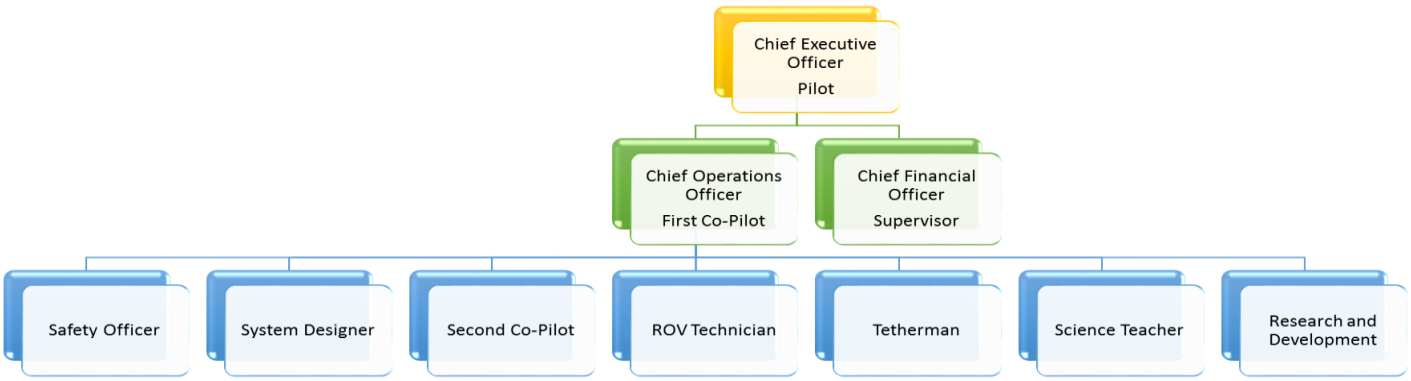
ORGANIZATION CHART



DESIGN RATIONALE

Our ROV is quick because of its size and the array of the motors and has a very effective claw and visual system. Our first ROV for the regionals competition was bigger, but we realized that it was too slow and we could not accomplish all the tasks in time.

Our claw system is a very operative and trustworthy system. It is moved by a hydraulic system composed of two syringes, each connected at one of the ends of a tube through which water passes. One of the syringes is located on the claw and the other, we hold in our hands. This one is bigger, so we can pull or push the claw faster. Our claw also rotates 360 degrees. This is achieved by using a second hydraulic system. This second system uses three syringes and a plastic tube. Two of them are on one end and the other one is at the other end of the tube.

UVE has adjustable and detachable light and adjustable housing motors (you can adjust the position of them in 130°, 90° and 45°). The robot has commercially available systems because we experimented doing different things and they weren't effective. Our stability system resulted cheaper because we were using kickboard even though we attached it we could not secure it. We had to find another option and we decided to try the $1.99 swim noodles. With this alternative we were able to find the proper stability and buoyancy.

Another one of our ROV system which we consider effective is our visual system. Our visual system has two cameras one looking down with the purpose of us knowing where we put the props, and the other one looking directly to the claw so we can see what we are grabbing and basically so we could accomplish the entire task. We have only one monitor in which we change the channels depending on which camera we want to see. One the other side our main weakness is stability. We want the ROV to be stable so it can be more effective but that has been very difficult. Our robot has two swim noodles in the upper side on the sides of the ROV. Our safety system has proven to be very effective. The propellers of our robots are safe in shrouds that were made in a 3D printer. We started designing and printing until we found the right one which is one with holes so the water can enter and go out for propulsion. Our kickboard pieces were attached to the robot using zip ties, but for a safety issue we changed it to Velcro which works beautifully. Our ROV has many components, the PVC material

and video camera can be easily bought. Other components, like the shrouds we decided to create them in order for a better performance.

STRUCTURE/FRAME

Originally UVE had a rectangle shape, after the regional's we decided to make some improvements. We scraped UVE original body and we turned UVE into an "H" shape. In the modify design we took out every pipe that didn't have a functionality. With the changes of our original design we were able to accomplish a faster, smaller and lighter UVE.

The material that we used is mainly ½-inch diameter PVC pipes. We used O-ring, a gasket in the form of a ring with a circular cross section, typically made of pliable material, used to seal connections in pipes, tubes, etc. The motor shrouds protectors were 3D printed with the collaboration of the Pontifical Catholic University School of Architecture.

CONTROL SYSTEM

The control system is the MATE control system kit. The controller was an easy enough task to build; the only problem was trying to make the motors work. Before the regionals, the motors didn't work. We decided to dismantle the controller and corrected the problem. The problem was caused by a bad weld which after fixing, all motors started to work fine.

Our company decided to use the analog control system since it was easier to use. We achieved to control the UVE using a motor-simulator board with two Sabertooth microcontrollers. The motor simulator board provides information about the status and direction of the motors. The Sabertooth microcontroller has shown to be reliable and versatile granting us to make the desired ROV. The Sabertooth microcontroller was connected to joysticks that are input devices consisting of a stick that pivots on a base and reports its angle or direction to the device it is controlling, also known as the control column. We have a volt/amp/watt meter for continuous system monitoring. The control system has

a main switch, also known as kill-switch, which is also known as an emergency stop. The kill-switch is a safety mechanism used to shut off the device in any situation, it shuts down all the systems instantly turning the vehicle off without damaging it all of this in less than 5 seconds. Our company has a blade fuse holder that connects to the battery or main source of power. These components are the essentials of the Triggerfish SeaMate Kit. Keeping this system allow us to save money and have a reliable system, it led a space for creation and designing of the control box, but it was more for the purpose of comfort and esthetic, since it complied all the functions we needed. The tether is holding the 8 conductors from the 4 motors, the 2 cameras for visibility and the hydraulic systems tubes. Our control system was made to keep it simple. We waterproof the electrical connections by applying hot glue to all the welded area and sealed them with shrink tubes using a heat gun.

BALLAST SYSTEM

Stability is the property of a body that causes it, when it is disturbed from a condition of equilibrium or steady motion, to develop forces or moments that restore the original condition. One of the most important concepts on our ROV is stability, because stability makes it move or act one way or another underwater. Stability is the key if you want to control your ROV quickly and effectively to execute all of the tasks.

In our first prototype, the stability system was composed of two rectangular pieces cut off a swimming paddle for kids. They were attached to the ROV with tie wraps. However, we had a lot of problems with them, because they would move and made it difficult to stabilize the ROV.

Our current ballast system consists of two swimming noodles that are located in the upper part on both sides of the ROV. They are attached to it with Velcro. Also, all heavy components of the ROV were arrayed so the weight was evenly distributed within the ROV.

PROPULSION SYSTEM

UVE has 4 motors of 500GPH each. These motors are the ones included in the SeaMate Triggerfish kit. Two of them are in a vertical position and the other 2 are horizontal. In other words, we have 1000GPH to go backwards and forward; and also 1000GPH to go up and down. Positioning the motors this way allows us to move towards any direction we need to go.

Our ROV uses approximately 24.5 watts, we measured this using the Wattmeter. The power consumption is related to the thrust of one motor because of the force the motor makes to the opposite way the ROV wants to move.

NAVIGATION SYSTEM

The navigation system consists of two cameras and one monitor. One of the cameras is directly looking to the gripping system so we can see what we are grabbing, what we have in front of. The second camera is looking down so we can see where our UVE is located and where are we collocating the props. In our control, we have a monitor. In the monitor, we change the source depending on what camera we want to see. The type of camera we used for the navigation system is a Car Rear View Camera. We used this camera because it was cheap and we could waterproof it. We waterproofed both cameras in an acrylic cylinder in which we made a gap in one of the sides so the cables can pass through it. We glued the camera in an acrylic lid with epoxy then we glued the lid to the cylinder. We organized all the cables into the cylinder and poured an epoxy mix so it was waterproof.

GRIPPING TOOL

The gripping tool that was installed in our ROV is a VEX Claw. We have this claw because it is a cheap, and it has resulted effective. It can hold and up objects up to 10 pounds. We made the claw a system so it could rotate 360 degree. The claw rotates, opens and closes with hydraulic power.

HYDRAULIC SYSTEM

In our ROV we have two hydraulic systems. The first system we have is for opening and closing the claw. This one is composed by two syringes and one tube. One of these syringes is attached to the claw and the other one is on the topside so we can manipulate the movement. They are connected by the tube.

The other system is for rotating the claw at 360 degrees. This part is consisted of three syringes and one tube. Two of the syringes are located in a plaque that is attached to the claw and the other one is on the topside so we can manipulate the movement, they are also connected with a tube.

SAMPLE COLLECTION SUCTION TOOL

In one of the competition missions our company's ROV must collect a sample of a substance called agar. Our system is not complicated at all. It only consists of 2-inch diameter PVC pipe, which we are going to grab with our own gripping system. The purpose is to take the PVC pipe with the claw, get it to where the agar is, press it down to the agar and then get it to the surface so we can put it in the container and see how much we grabbed.

COLLECTION BASKET

In various tasks our company's ROV must collect and retrieve objects to surface. CYLON, Corp. created a collection basket to collect beacons and retrieve them and the fountain to surface.

B- BUOY

To complete the risk mitigation task, identify the contaminant cargo container is required. CYLON, Corp. created a buoy using a balloon attached to a rope.

CRANE SYSTEM

For task number 1 the company has to install a frame onto its base plate. For this we built a crane made out of 2- inch diameter PVC pipe. Two members of the company will be managing the crane. One of the tether men is going to pull a rope to control a hook. The other will be controlling the position of the crane.

SAFETY

The Company Safety Review is a requisite document for the MATE ROV International Competition. It is used by the Safety Officer to verify that the ROV comply with all the safety requirements that the competition asks for. Every time UVE enter the water the Safety Officer should check the Safety Review and the Safety Protocol Checklist. The Safety Review includes the most important safety aspects that includes underwater and topside of the UVE.

Safety considerations including in the Company Safety Review

ANDERSON POWERPOLE CONNECTORS ARE THE MAIN POINT OF CONNECTION TO THE MATE SUPPLY.

ELEC-001: Power supply connections are Red/Black Anderson Powerpole Connectors**.**

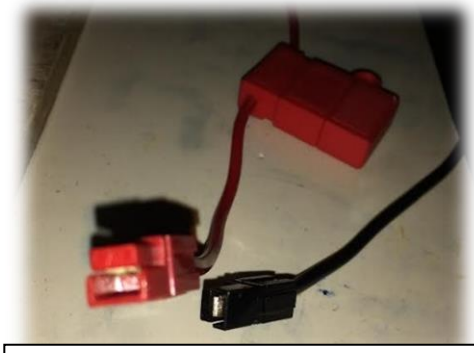


Photo #1: Anderson Powerpole Connectors

A PROPERLY SIZED FUSE OR BREAKER IS WITHIN 30 CM OF THE MAIN POINT OF CONNECTION.

ELEC-008R: The fuse or circuit breaker must be installed in the positive power supply line within 30 cm of the power supply attachment point.

Photo #2: Distance between Anderson Powerpole connectors and fuse

FUSE CALCULATIONS.

ELEC-008R: The ROV system must have a fuse (or circuit breaker) that is calculated based upon the maximum current draw of the ROV. This overcurrent protection must be calculated as follows: ROV Overcurrent Protection = ROV Full Load Current * 150%. The overcurrent protection value may be rounded up to the next standard fuse.

ROV Overcurrent Protection:

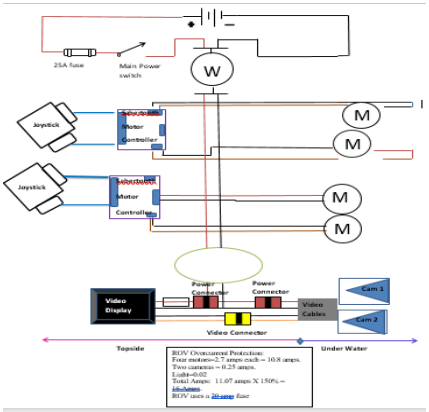
Four motors=2.7 amps each = 10.8 amps.

Two cameras = 0.25 amps.

Light= 0.02

Total Amps: 11.07 amps X 150% =16.60.

ROV uses a 20 amp fuse.



NO EXPOSED WIRING IN CONTROL BOX.

ELEC-017R: The inside of the control does not have exposed wiring, the Control Box is neatly laid (ELEC-022R) Wire joints properly sealed using hot melt glue covered with shrink tube. No AC is used (ELEC-023R).

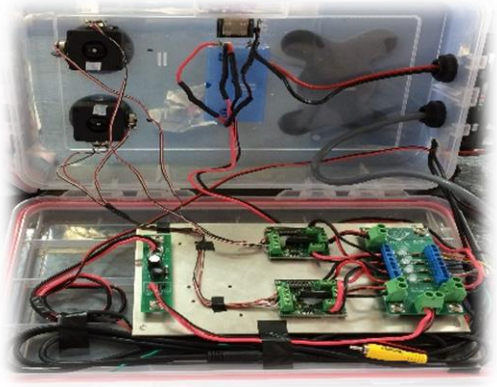


Photo #4: Control Box wiring

USE OF STRAIN RELIEF.

ELEC-024R: All wires entering and leaving the control box have a proper strain relief. Our control box uses one strain relief and two O rings.

Photo #5: Strain Relieves and O rings

AUTORIZATION TO USE FLUID POWER.

FLUID-014: CYLON CORP. took the Fluid Power Quiz and passed

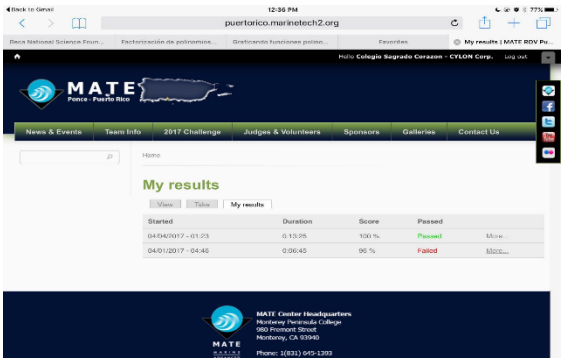


Photo #6: Fluid Power Quiz results

ALL PROPELLERS ARE SHROUDED.

MECH-006: Shrouded completely encircle the propeller and extend 2 mm in front and behind the propeller.

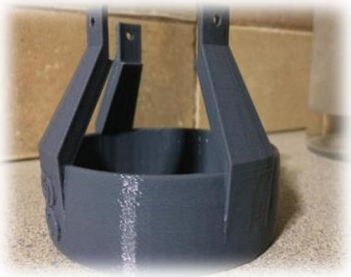


Photo #7: 3D printed shrouded

Photo #8: Propellers are shrouded

THE ROV HAS NO SHARP EDGES THAT COULD CAUSE DAMAGE.

MECH-006, ELEC-017R: The ROV has no sharp edges and the hazardous items are identified.

Photo #9: UVE ROV

SAFETY CHECKLIST PROTOCOL

Colegio Sagrado Corazón de Jesús Ponce, Puerto Rico

MATE ROV 2017 International Competition, Long Beach, California

C.Y.L.O.N CORP.

Before entering the ROV into the water the Safety Officer must complete the Safety Checklist Protocol.

Safety Officer_____

Date_____

Location_____

Time_____

Signature_____

Comments_____

_____

REQUIREMENTS	YES/NO
NO SHARP EDGES ON THE ROV	
PROPELLERS ARE SHROUDED	
NO EXPOSED WIRES	
NO LEAK ON THE HYDRAULIC SYSTEM	
CORRECTLY ATTACHED WIRES	
FLUID POWER QUIZ PASSED	
NO CORROSION IN THE CONNECTORS	
ANDERSON POWERPOLE CONNECTORS ARE THE MAIN POINT OF CONNECTION	
ALL WIRES ENTERING AND LEAVING THE CONTROL MUST HAVE A STRAIN RELIEF	
SAFETY GARMENTS (SAFETY GLASSES, PFD's)	
THE ROV SYSTEM MUST HAVE A FUSE THAT IS WITHIN 30cm OF THE MAIN POINT OF CONNECTION	

FINANCIAL REPORTS

Projected Product Costing 2017

Process/ Component	Estimated Cost
Frame	$65.00
Tether	$215.00
Visibility	$235.00
Propulsion System	$985.00
Control System	$565.00
Miscellaneous	$500.00
Total:	$2,565.00

Final ROV Cost 2017

Category	Item	Type	Amount Paid	Actual Value
Frame	(7) PVC 3/4" T joints	Purchased	$4.00	$4.00
	(3)PVC 4 way T joints	Purchased	$2.00	$2.00
	(1) PVC cross	Purchased	$3.00	$3.00
	(12) Tie Wraps	Purchased	$3.00	$3.00
	(8) Plugs	Purchased	$12.00	$12.00
	(6) PVC Rings	Purchased		
	(2) PVC Elbow joints	Purchased	$5.00	$5.00
	6 Pack Black BNDLNG Straps- 1/2" X 8"	Purchased	$4.38	$4.38
	3/4" 10 ft. PVC Tube	Purchased	$20.00	$20.00
		Subtotal:	$53.38	$53.38
Propulsion System	Clear PVC Tubing 50 inch	Donated	$0.00	$16.00
	Syringes(3)	Donated	$0.00	$4.00
	Thruster motor (4)	Donated	$0.00	$100.00
	Thruster Mount (PVC Reducing Tee) (4)	Donated	$0.00	$32.00
	Trigger Fish Motor Simulator Kit	Donated	$0.00	$30.00
	Trigger Fish Propeller Kit	Donated	$0.00	$30.00
		Subtotal:	$0.00	$182.00
Control System	Trigger Fish Control Box Kit	Donated	$0.00	$460.00
	Control System Upgrade	Donated	$0.00	$55.00
		Subtotal:	$0.00	$515.00
Visibility	TFT LCD (color monitor)	Purchased	$28.99	$28.99
	Camera Power Filter	Donated	$0.00	$14.00
		Subtotal:	$28.99	$42.99
Tether	Trigger Fish Tether Kit	Donated	$0.00	$93.00
	40 ft. Grey Poly Cable	Purchased	$57.00	$57.00
	40 ft. Black Poly Cable	Purchased	$57.00	$57.00
		Subtotal:	$114.00	$207.00
Other	Spacer Pack	Donated	$0.00	$7.00
	Vex Claw Kit	Purchased	$20.00	$20.00
	Steel Bar Pack	Donated	$0.00	$13.00
	Nylock nuts	Donated	$0.00	$36.00
	Epoxy Clear	Donated	$0.00	$8.00
		Total:	$196.37	$1,000.37

CHALLENGES OVERCAME

Technical - One of our challenges is to be able to comply with all the rules that MATE has. Famech's Corp. achieved this with the use of different methods. First, the frame was widened and shortened. The change of its measurements was needed for our robot to be correctly positioned so it wouldn't cause any damage to itself. At the time of assembling the equipment we must take into consideration the size of the frame. With this we will be able to know if the weight, size and if the tethers are correctly positioned and correctly fit the regulations of the competition. All this combined helped us to overcome the challenge.

Non-technical – There were some logistical difficulties. The distance between where the project was taking place and where each person of the company lived caused it to be difficult for everyone to be at the same place at the same time. But while putting aside the distances and inconveniences there was excellent communication between the members. To avoid any miss-communication FAMECHS Corp. decided to make several connections through social network. This helped all members whether they are the parents, the teachers or the students. They are always well informed of what was happening and everybody was up to date.

FUTURE IMPROVEMENTS

As a company of entrepreneurs, we experienced a lot changes in the prototypes and structure inside the Company, but we keep improving for future project designs of the robot for each task in an effort to determine which prototype we

would use. Also, we hope to minimize wasted time, money and energy on prototypes that don't comply with specifications processes, and practices. To improve the claw for the future, we're going to have it rotate and have a better grip. The materials we will need we will preorder them to not waste time and to have everything complete and ready before their deadline.

REFERENCES

2017 MATE ROV competition manual: ranger. Marine Advanced Technology Education. Retrieved March 08, 2017, from http://www.marinetech.org/

Moore, S. (2010). Underwater robotics: science, design, and fabrication. Monterey, CA: Marine Advanced Technology Education.

QSTAR, SL (2014). ROV Familiarisation Basic Introductory Module. Canary Islands, Spain.

ACKNOWLEDGEMENTS

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Eng. Armando A. Rodríguez Torres, Mentor

Eng. Raúl Santiago Gautier, Assistant Mentor

Mr. Gerald Lebrón, Teacher

Ms. Aymette Medina, Learning by Doing, MATE Regional Coordinator

MATE CENTER

NOTICIAS DE PONCE for media coverage

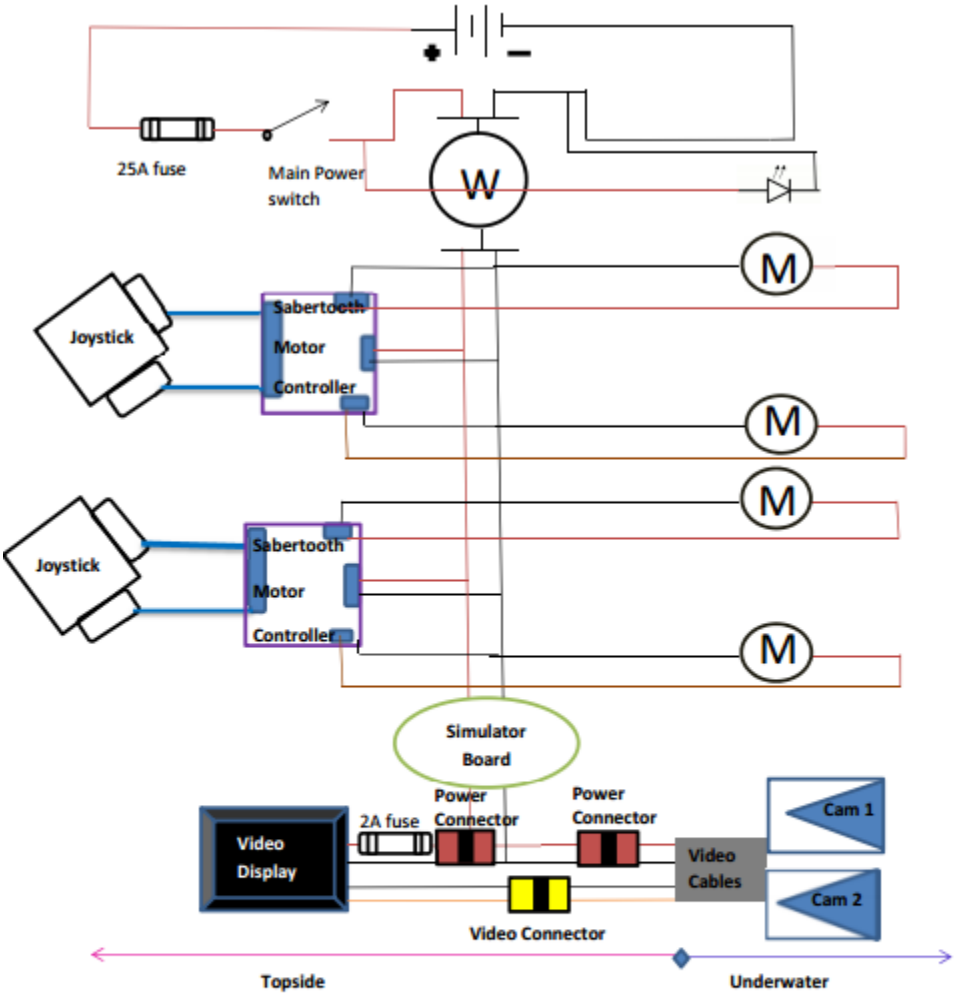
CIAPR Ponce – Fluid and Safety Workshops

Parents and relatives for moral support

Autonomous Municipality of Ponce for pool facilities

APENDIX A – ROV Photo

APENDIX B – SID



FUSE CALCULATIONS CYLON, CORP.
ROV Overcurrent Protection:
Four motors=2.7 amps each = 10.8 amps.
Two cameras = 0.25 amps.
Light=0.02
Total Amps: 11.07 amps X 150% = 16.60Amps.
ROV can use a 20 amp fuse, but we are using a 25 amp fuse

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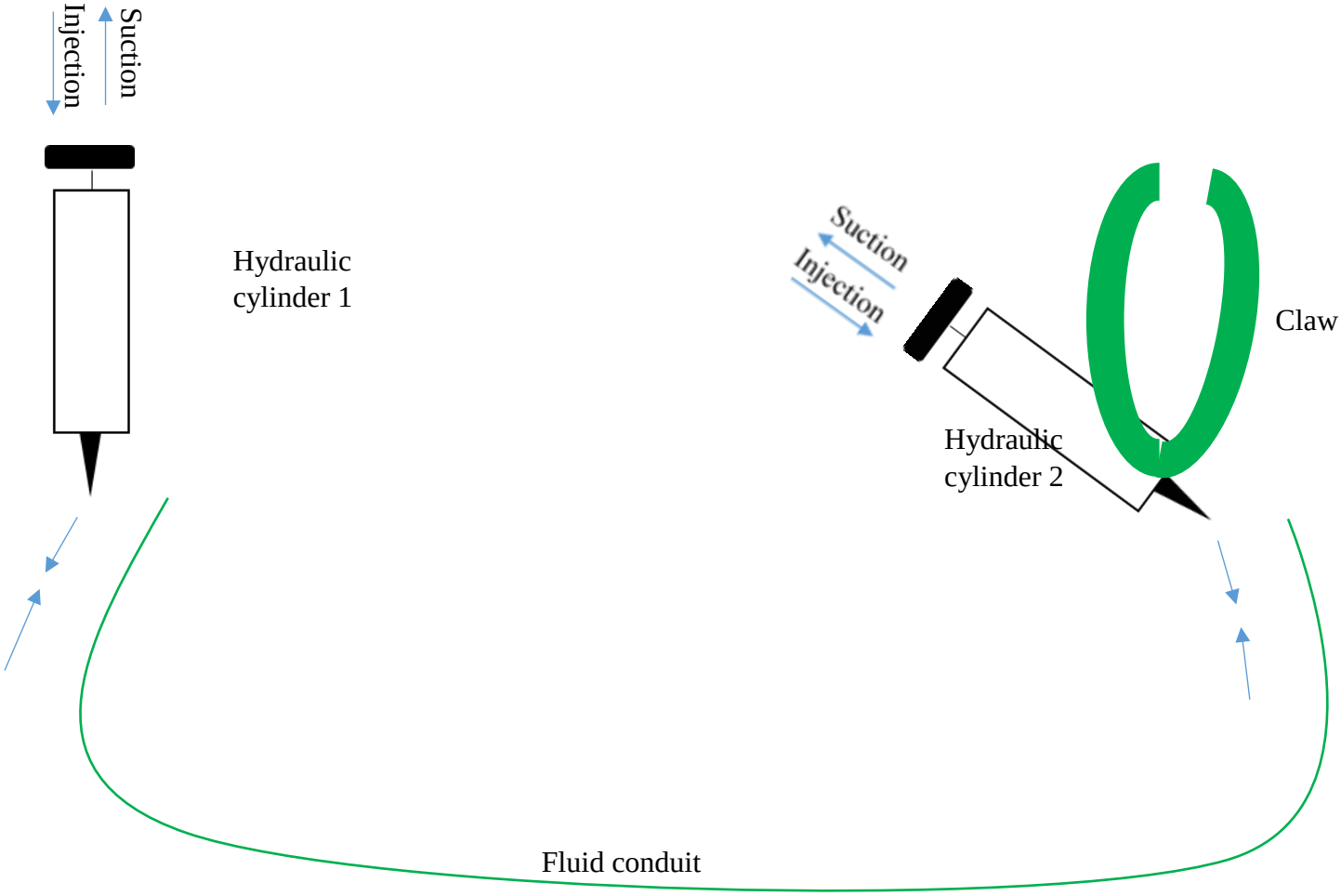
Colegio Sagrado Corazón de Jesús

Ponce, Puerto Rico.

APENDIX C – HYDRAULIC SYSTEM 1

HYDRAULIC SYSTEM SID

CLAW OPENING AND CLOSING



Functions:

Hydraulic cylinder 1: injection (claw opens) and suction (claw closes).

Hydraulic cylinder 2: injection (claw closes) and suction (claw opens).

Fluid: water

CYLON, Corp.

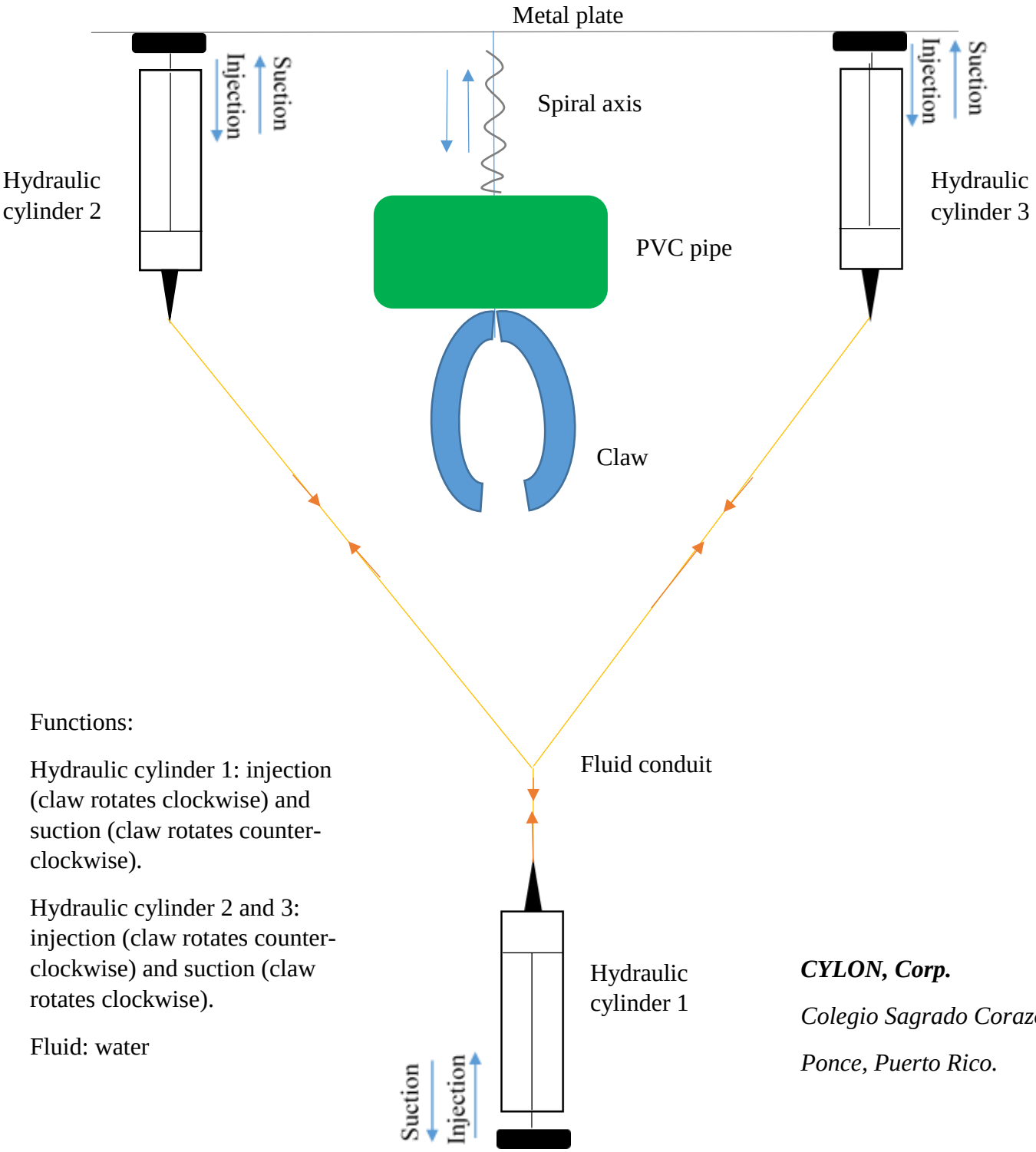
Colegio Sagrado Corazón de Jesús

Ponce, Puerto Rico.

APENDIX D – HYDRAULIC SYSTEM 2

HYDRAULIC SYSTEM SID

CLAW ROTATION



Functions:

Hydraulic cylinder 1: injection (claw rotates clockwise) and suction (claw rotates counter-clockwise).

Hydraulic cylinder 2 and 3: injection (claw rotates counter-clockwise) and suction (claw rotates clockwise).

Fluid: water

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Ponce, Puerto Rico.