What is a PLC?

PLC stands for programmable logic controller. A PLC is a digital computer that is used for automation of industrial electromechanical processes, such as controlling different machines. PLCs are designed for multiple arrangements of digital and analog inputs and outputs, extended temperature ranges, immunity to electrical noise, and resistance to vibration and impact. A PLC is a real-time system since its system output must be adjusted based on input conditions. In short, PLCs are reliable and durable programming equipment that can be used to control a variety of different industrial machines like a glass cutting machine.

How does a PLC work?

A PLC is a specialized computer used to control machines and processes. Unlike typical computers the PLC is designed to survive in a rugged industrial atmosphere and to be very flexible in how it interfaces with inputs and outputs to the real world. The three core components of the PLC are the power supply, CPU, and I/O ports.

The power supply supplies regulated DC power to the PLC. The power supply will generally run off of 120 VAC or 24 VDC sources. This means that depending on the PLC that is selected it will most likely be able to be powered by a standard wall outlet. There more powerful PLCs that would require an external power supply but those are used for applications that are far more complex than ours.

The CPU is like the brain of the PLC. This is where a microprocessor, memory chip, and other integrated circuits come together perform logic control, monitoring, and communications. The CPU of the PLC has different operating modes. Programming mode allows programs/logic to be downloaded from a PC source. Run mode is what the PLC is set to when functional operation is desired. Since a PLC is a dedicated controller it will only process a singular program over and over again. Once cycle through the program is called a scan time and involves reading the inputs from the other modules, executing logic based on these inputs and then updating the outputs accordingly. The CPU memory stores the program, statuses of I/O, and can store values if necessary.

There are many different types of I/O configuration for a PLC. Input devices can be either digital or analog. Digital inputs are specific values or on/off, analog inputs on the other hand need to have their voltage or current converted to a digital equivalent number before they can be processed. Outputs can also be both digital and analog. A digital output would turn something on or off. An analog output would be converted back to its voltage or current representation which can then be used to drive mass flow controllers, pressure regulators, position controls, and more.

Typically a PLC is programmed using special software from the PLC manufacturer. The most widely used programming form is known as ladder logic. Ladder logic uses symbols to emulate real world relay logic control. These symbols are connected by lines to indicate the flow of the program. The completed program will look like a ladder, hence ladder logic, but it will actually be representative of an electrical circuit. Ladder logic is similar to the LabVIEW programming platform whereas both programs are more based in symbolic representation than in actual words like most programming languages.

Why do we want to use a PLC?

We want to use a PLC because it was brought up by other glass cutting teams and it seems like the most logical decision. A PLC is flexible enough to allow as many I/O ports as we will need. A PLC also has the programming power required to control multiple subsystems at once. PLCs were also created for industrial machine control which is exactly what we are doing. Once the program is set up it never needs to change, the only thing that will change are the inputs based on what type of glass is being cut. The system outputs and functionality will never need to change.
How do we plan to use the PLC?

After talking with other glass cutting teams it seems the consensus plan is to utilize a single PLC for all three subsystems. This will make combining the subsystems infinitely easier than if we all had separate control systems. The control and sensor signals from each subsystem will be plugged into the same controller. Individual control programs for each individual subsystem can be created using the PLC. Those individual programs can then be combined into one master program that controls the functionality of all parts of the system. The difficulty will come from all groups needing to program on the same piece of hardware. However, depending on the PLC that is selected a program could be written without the PLC present and then downloaded at a later date and tested.

PLC Selection Criteria

- System requirements
  - What do we want to achieve?
  - Break down the task into basic elements
- Application requirements
  - Find a device based upon specific function required
- I/O capacity required
  - How many inputs do we need for all 3 teams combined?
- I/O types required
  - RS 232, Analog, Digital, etc.
- Memory required
- CPU speed requirements (for certain applications)
  - Does our system require timing that is quicker than normal?
    - Probably not
- Electrical requirements
  - Input/output power/voltage necessary
- Operation speed
- Communication requirements
- Software
  - This will be determined by what PLC is chosen
- Operator Interface
  - How will Ray be able to operate the program/system
- Physical environments
  - Consider where the PLC will be placed