PRIMARY DEVELOPERS:
Glenn Wisniewski – Corporate Trainer, Henry Ford College
Wes Bye – Mechatronics SME, Pontiac Coil

Mechapracticum Outline

Advanced PLC

Topic: Advanced PLC

Estimated completion time: 16 hours

Purpose:

The purpose of this Mechapracticum is for the participant to demonstrate their ability to operate the PLC as prescribed in this document.

Instructional Outcomes:

The participant will demonstrate the application of their skill and knowledge in the following topical areas:

- Adv. Plc
- PLC
- Electro-pneumatics
- Basic electricity
- Safety

Instructions to Students

In a steel mill, the ladles that carry the molten metal have to be re-lined with a type of fire brick on a 6 month basis. After re-lining the ladle the mortar securing the bricks has to be heated to cure.

You are going to create a basic PLC program and HMI screen to control and display this simple process. We are not controlling the Temperature process, just initiating a Temp Controller. Please refer to the attached Timing Diagram.

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There are 3 outputs: Close clamp, close Lid, and initiate the temperature controller.

The inputs are:

SW 1 – Initiate process

SW 2 - Clamp is closed

SW 3 – Lid is closed

SW 4 – Increment T2 (by ½ sec.) – Note this can also be done through the HMI

SW 5 Decrement T2 (by ½ sec.) – Note this can also be done through the HMI

SW 6 – Reset alarm/function

SW 7 – Cycle complete from the Temperature controller.

The timing of the sequence will be provided by your evaluators/instructors.

It should be noted that T2 is a variable. It starts at 10 seconds but can be adjusted from 5 to 15 seconds through the HMI or through switches 4 & 5.

Once SW7 is closed, SW1 must be turned off and the circuit must be reset to initiate a second sequence. After this operation, T2 will always be reset to 10 sec.

T1 is always 3 seconds.

Under normal operation the T2 time is set on the HMI and then the system is initiated (SW 1). A Variable time on T2 allows for different size lids to be used for differing Ladle sizes. Incrementing and Decrementing is done in ½ second intervals.

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Once the system is initiated:

- SW2 must be closed in three sec.
- Following SW2, SW-3 must be closed in a timeless that the displayed T2 on the HMI.
- T2 cannot be toggled to increase above 15 sec. or below 5 seconds.

Should any of these conditions not be met, the alarm goes on, all outputs go off, and the circuit has to be reset after turning off SW1. The alarm must be reset to initiate a new cycle. Sample HMI screens will be provided by your instructor or you will be responsible for the design depending on the school.

A second utility screen is offered for the operator to help them convert from Fahrenheit to Centigrade. The Fahrenheit input is adjustable from 0 degrees to 2500 degrees in 100 degree increments.

The Increment and Decrement logic in the program must be in a separate subroutine. The Fahrenheit to Centigrade conversion must be in its own subroutine.

The program must include sufficient rung comments and descriptors to be easily understood by the evaluator when viewing the programming terminal.

You are to initiate communications with the processor, design, enter, and debug the program and demonstrate the proper operation to the evaluator.

Additionally, you will have to demonstrate the ability to input a signal from an analog device and affect the ladder logic. This activity will vary by school and available equipment. Your instructor will provide this additional information.

Safety

The student will demonstrate all safety practices learned previous instruction.

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Instructions to Evaluator:

The standard Siemens Trainer found at OCC or HFCC will support this activity. The OCC/HFCC instructors can identify the model number that is purchased from Siemens.

1200 programming software should be used.

This defines all the equipment necessary to support this activity with the exception of a Potentiometer and power source to facilitate the analog input activity.

The original thought regarding the logic was to have a HMI adjustment of Time 2 or Manual switches to increment and decrement T_2. You could easily ask the students to forgo the Manual switches and to use the HMI only.

The HMI screen layouts will reflect your requirements. The original thought was to have a an Arrow up and down button(s) next to the Fahrenheit Display that would be used to enter the Fahrenheit (in 100 Degree increments) For advanced students, a rapid scroll could be added after depressing for 2 sec.

Most Plant prints that were evaluated prior to their involvement in MAT2 reflected standard ladder logic was in use. If you elect to add additional Language requirements for the subroutines, this is your option.

Program documentation is critical… If the operation of the program is not obvious from the screen, demand that the students continue to expand. This is a critical if they should ever have the opportunity to program at their plants.

You may also add some additional requirements to reflect advanced concepts that were developed. This instruction sheet is meant to define a minimum required skill.

Required Equipment and Materials:

N/A

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Rubrics:

	Skill Outcomes	PTS	*(A) Highly Proficient*	*(B) Competent*	*(C) Partially Competent -Developing*	*(D) Limited*	*(E) Major Improvement Required*
1	Interpret the written assignment and translated into Program	10	Student asked clarifying questions but needed no assistance to solve logic requirements		Needed some prompting to identify program solution		Unable to translate written problem into program
A	Program and HMI functions as desired	25	Program and HMI functions as required		Program and HMI partially functions		Program and HMI did not function properly
B	T2 adjustable as required	10	T2 fully adjustable		Student required minor prompting		Student could not solve the Incrementing and decrementing requirements without support
C	Alarm working as required.	10	Alarm working as required		Needed some prompting to select the appropriate instructions		Student needed SME to define the logic and the instructions to be used.
D	Demonstrated proficiency in utilizing the analog input.	10	Analog input functions properly, no assistance given be SME		Needed some prompting by SME		Student needed SME to define the logic and the instructions to be used.

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E	Fahrenheit to Centigrade conversion functioning properly	10	Conversion software functions properly. No SME assistance required		Needed some prompting by SME		Student needed SME to define the logic and the instructions to be used.
F	PLC logic documentation	25	Evaluator did not require any further information from the student to understand the logic		Evaluator had to ask several questions of the student to understand the logic		Logic could only be understood if the student explained its operation
	Safety	**PTS**	**(A) Highly Proficient**	**(B) Competent**	**(C) Partially Competent/Developing**	**(D) Limited**	**(E) Major Improvement Required**
1	Safe Work Practices	25	Used appropriate PPE; practiced common safety practices		Most safety practices used		Demonstrated unsafe working practices
2	Safety Attitude	25	Work practices demonstrated safety consciousness in all procedures; looked out for safety of others		Most of the time worked safely and showed some concern for safety of others		Dangerous worker; did not look out for safety of others

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3	Electrical safety practices	25	Used appropriate control energy and safety procedures				Dangerous worker around electrical
	Tool Use	**PTS**	***(A) Highly Proficient***	***(B) Competent***	***(C) Partially Competent/Developing***	***(D) Limited***	***(E) Major Improvement Required***
1	Use of Diagnostic Tools (Programming terminal)	25	Correctly and efficiently use of diagnostic tools in an appropriate manner		Somewhat efficiently; mishandled one or more of the tools		Had to have assistance in using diagnostic functions of the terminal or DVM
	Work Habits	**PTS**	***(A) Highly Proficient***	***(B) Competent***	***(C) Partially Competent/Developing***	***(D) Limited***	***(E) Major Improvement Required***
1	Work Attitude	15	Alert to finding and correcting problem		Honestly attempted to find and correct problems		Showed frustration in finding and correctly problem
2	Work Procedure	25	Always followed standard procedures; demonstrated planning and organization skills in correcting the problem		Complied with standard procedures; Showed some plan and organization in working		Did not follow standard procedures; Disorganized and slipshod methods;

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3	Professionalism	20	Work showed pride in accomplishment		Tried hard and shows promise		Work lacks praiseworthy factors
4	Self-confidence	15	Appeared comfortable and posed when performing tasks		Fairly self-confident; occasionally disconnected		Hesitant, timid, uncertainty
5	Knowledge of job	25	Has an exceptionally thorough knowledge of the job		Has good knowledge but needed coaching		Has inadequate knowledge of job

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