Lab 3: Basic HMI Lab

Background：

Human Machine Interface(HMI) provides ability to view data and tags from RTAC and also do controls from remote location through web interface. There are three characteristics of HMI. First, it is web-based, so we do not need special software on your PC or substation. You can view the HMI from anywhere you have a network connection to the RTAC. It is also very secure, so you don't have to worry somebody log in and view the data that they don't suppose to. All of the information you have configured in the RTAC applies the HMI account as well. Second thing is that diagrams are contained in RTAC itself. So you don't have to load the RTAC diagrams to one PC move them to another. Last but not least, diagram builder software is very important to our lab. It provides ability to build diagrams and load the in the RTAC.

HMI is widely applied in substation control. The purpose of this experiment is to familiarize students with the operating principle of HMI and how to design their own operating circuit. Send the circuit to RTAC and monitor the data you want.

Learning Outcomes:
1.   Understand the equipment to be used in the experiment（almost same as lab 2）
2.   We are going to use a new piece of software in this experiment (diagram builder software)

Equipment needed:
1.   Hardware:
      SEL 849
      Laptop
      KoCoS
      SEL RTAC
      Wires for connection
2.   Software:
      Diagram builder software
      SEL AcSELerator RTAC

Procedure:
1.   Connection：
      1.1 Connect the power supply with wires
      1.2 Leads I1, I2, and I3 go through the CT openings in the SEL 849
      1.3 All three wires are connected to the ground wire to form a loop
      1.4 Measure the voltage on the three phases corresponding to V1, V2 and V3 connected to the KoCoS-ARTES and the RTAC

2.   Setting：
      2.1   KoCos ARTES: Students can use set the testset to supply specific values of current, voltage or. frequency. However, KoCoS has a disadvantage, because it does not belong to SEL product. So we can not start/shut down on HMI during the lab. If we use motor,

we can do this

2.2 SEL AcSELerator: Students can create their own project in this software.

    1.   Choose the project you created for Lab 2

    2.   Choose the device you want to connect to RTAC (in this lab we need SEL849) by right clicking on "add device" and adding SEL 849

    3.   To make sure students can measure the data they want, we need to add tags, choose the tags on Meter. Turn it from false to true, in that case you already add the tag in AcSELerator RTAC.

    4.   Click on Tags, you can see all tags in AcSELerator RTAC

    5.   Click go online to make sure SEL 849 is connected to the SEL RTAC. (password is ▮▮▮▮ and log in). We can see the state of connection on the controller. If offline is false, this means it is connected. Sometimes we should wait for a moment.

2.3 Diagram Builder Software: In this part we will give a model of diagram, because let students draw a perfect diagram within 2.5 hours timeframe is too difficult.

    1.   Open the software and create a new project

    2.   Open the diagram which our mentor Joe Stan provided （Students can do some modification on this diagram. For example, in my test, I remove the tags of start and control, because I can not control KoCos in the test）
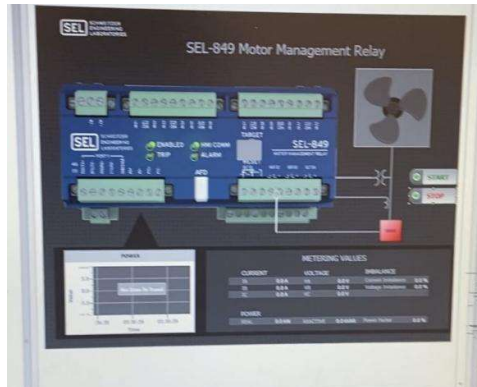
    3.   Connect the RTAC, so that we can import RTAC tags, click on the import. (IP address: ▮▮▮▮ use name ▮▮▮▮, Password: ▮▮▮▮) Connect type choose direct to RTAC, because we already save the tags we want in RTAC.

    4.   Click on tags on the left side of the screen，and drag the desired tags into the diagram

5. We can do some settings on the tags, there is a very interesting control. We can design the alarm color. For example, we can set the alarm color of the current to be red so that the current becomes red when it exceeds this value that you set. All we need to do is click the tag, and the relevant operation is on the interface on the right.

6. When you have finished your diagram design, you can click save and then upload it to RTAC.

3   Measure:

    3.1 online the RTAC

    3.2 Turn on the KoCoS

    3.3 Open the google chrome

    3.3 Input: ██████████ （use name: █████ password ████████)

    3.4 Click the HMI tab, you will see the diagram you build in the software

    3.5 We can see the data we want in the interface (additional idea: we may see in the. Lab two. The voltage you measure is equal to the voltage you set times 1.732)

Check List	
equipment connection	put tags into diagram
set alarm value of current and voltage	Upload the diagram to SEL RTAC
Open the HMI and measure the data	Repeat the experiment by modifying the voltage and current

Suggestions:

The main part of lab three is to let students know how to draw the diagram and upload it to RTAC. I think it is possible to measure voltage, current and frequency in groups of three. Because of the difference in measurement data, students only need to add the tag they want. The final diagram may be different depending on the experimental equipment. For example, the power supply of my experiment is KoCos, so I cannot control the power switch. However, if motor can be used instead, then we can add a switch device into the diagram. Although I have not tried it, I feel that I can successfully control the switch.

Some ideas of lab's future development (from Dakota):

Because the experiment seemed so simple, we decided to put experiment 3 after experiment 4 in order to increase the length of the experiment. If a future group would like to add more steps, they could move the lab to incorporate the SEL 351. Students could begin this hypothetical lab by following the same steps. Afterwards, they would create an additional HMI for the SEL 351 following the same process as the 849. They could also implement a smaller HMI showing the two devices on a one-line diagram and indicating if they are open or closed.