

### **1.Can we join the lab remotely?**

I think we have access for the remote control, then there can be someone in the lab to set the things up. This can be arranged. We do have the team's work which can be controlled remotely with sufficient network. There are things we could set up to record data, also there are some equipment you can send commands and control remotely, like a human machine interface that people can interact with it remotely to control the system or whether there is web page or whether we have other ways setting things up. There is something we can use, like a Modbus or DNP3.

### **2.After reviewing all the 3 labs, is our goal to simulate a measuring system to connect each electrical box use in the lab and to collect dates for students to analyze? If is, how do we do in details?**

We haven't set up, but there is a simulation to estimate how value changes every time. So, we can imitate some SCADA system behaviors with that.

So for example, that their power system simulators, I guess I see a couple directions you could go on this. One is looking at some of the things that the team did last year. They were basically putting together the systems to be able to do the measurements. And that a little bit of post processing on those, some of it would be thinking those experiments it had last year and coming up with remote equivalent to those experiments that are more involved than just simply videotaping somebody doing the lab and then having the off campus students look at data.

So like I say there are couple of options. One is there are something there are things that we could set up in the lab where are the equipment is set up to has a bankrupt recording. So we can save data.

And some part of one of the options would be some of the equipment which is you can actually send it commands to control it remotely or whether we could have a human machine interface.

People could interact with remotely that controls the system or whether that's on a web page or whether we have some other way of setting that up. And joe may have some suggestions on how to do this because that's part of what some of the products is set up to do.

The question is what we would need to have on somebody's computer to do that if we were using something like Modbus in DNP3, there are actually libraries where we could use other programs that can produce that sort of data.

### **3.What should we learn something relevant to our project after we finish ECE544/444 course?**

I think that's probably a good point.

There's but I think that's something that we had hoped that you as the team would be able to discern kind of look at the material in the ECE444 class. And gather some useful information out of that, you know, the material that we're looking to put together for this industrial control classes is new material. It's not exactly what is in the ECE444/544 class, although it's very closely related. The ECE444/544 class is very much integrated around the protocols and the communications. This is a little bit more looking at the controls and the controllers and the devices themselves looking at settings and how they can use protocols and communications. And those

sorts of things really interfacing with the devices. So you as a student interacting with one of the intelligent electronic devices and trying to learn what ways you can interact with it, whether it's over a serial interface or an ethernet interface or over with the front panel of a device if it has controls on the front panel.

And what sorts of things that you might want to look at as far as settings and configuration, be that for communication protocol support, be that for internal logic, be that for transferring logic or logic between devices and a variety of other things.

So, I think that's a really good point that a lot of the material in ECE444/544 is very useful since it's the vertical side of things. But it's not everything. Right? And there are some points in that material that maybe aren't as useful as the rest. And that's kind of why we would really have the two classes is because there is one that is going to have everything. But the two together going to be able to fill in the gaps of one another.

Does that make sense? Or am I just making that more confusing a little bit and you mean we should gather the useful information from the material.

#### **4. A little bit, and you mean we should gather the useful information from the material? And what do you think the next step we're going to do after that.**

I think there's a couple things you could do. Really, at this point, the lab courses that the last year's group put together are pretty good for the very bare minimum of getting some knowledge and gathering some knowledge for that material. I guess I didn't really say anything useful there.

The previous students put together some nice labs that kind of cover the basics. But we could do 1 of 2 things we could work on figuring out a way that those labs which were designed for on campus students, figure out ways that those same labs can be done by off campus students and not just a video recording like doctor Johnson and mentioned where the off-campus students would just look at data after the fact and analyze the data and not get hands on with the actual controls and controllers.

We can look at way trying to find ways that we can make those controllers accessible. The students off-campus without having to send out those devices from campus to the students. The other thing that we could look at is really just kind of flushing out or completing the material that the students have put together previously.

So those labs that were put together by last year students they're pretty good as a barely start, but we could really continue to draw those out. We could make those better and we could put together some more well-developed lab guidelines in terms of some kind of pre- lab setup that would be completed by a TA or an instructor.

If there's any pre lab material that the students themselves need to complete, of course the lab material itself and making sure that's clear easy to follow and helps drive home the points that the lab tries to teach the students.

And then the post lab material if there is any. So there's follow up questions that the lab asks if there's additional items that need to be completed by a TA or instructor to either reset the lab for the next student or prepare it for the next lab section. So, that's moving from lab 1 to lab 2 and changing out any device configurations or anything else. So I guess the two things that I see and maybe doctor Johnson can jump into but the two things that I see are looking at what ways can we create a network and some kind of configuration

on campus that students off campus can access it or kind of completing the the lab material and documentation that was put together by last year's group of students.

**5. Doctor Johnson is there any other anything else that i'm missing or that you can think of? (Joe Stanley)**

Well I think complaining the documentation might be hard to do if you don't have if they do the labs themselves. And so I think that would be a little bit of a challenge. There are there are some options for simulation that could they basically do simulation versions of some of those labs kind of like what I did in what I do in the relaying class where I have a mathcad relay. We can maybe be able to do that without using the mathcard. So, if there's some transient simulation programs for power systems that basically give you wave forms versus time. So when you look at a time domain wave form, and let me open something and then share my screen.

So the program i'm using is not necessarily the one that we might use for a project like this, but it's one that I can open something quickly. Yeah so this is a a simulation model for a power system.

So this is a power distribution system. So normally you would have measurements at different points. So it normally would have voltage and current measurements at different points in this system that would be communicated back through a system.

So one of the things when you run the simulation basically, this is going to give you a current to sign waves voltages of sign waves or with wisdom of distortion in them. And then usually in an actual system, you have measurement devices that process those and calculate if it's a SCADA system, they calculate rms voltage and they calculate real and reactive power and they may give you status of whether a switch is open or closed.

So one option is to be able to take those measurements, collect those and with something that's equivalent to way a way of communication system is working in a power system, have some control functions. The challenge with that is that when in those control functions quickly becomes a pretty big project. That might get a little big first in your design project if we're not careful.

So how we post process those it would be a challenge but trying to do something to do like the simple exercises like the labs that this the senior design group did last year maybe a possibility, or like the cyber security lab, maybe a hard one to do that way.

**6. Do you guys on the team? Do you know how to program in python? (Brian Johnson K)**

No, we learned matlab instead of python. We also did plc for the last semester in china WenZheng college.

**7. So do we need to learn how do you operate on python?**

No, if I already knew I there are some things that we could do to kind of direct this simulation, but I don't know if it's worth. If you're trying to learn a simulation and learn python, that might be a little much.

So like this simulation actually has control models in it. So this is actually equivalent to like something like a affordable take and burger. So you can control the real power and reactive power. So you can actually do as control functions. And that would be possible to do some simple control functions. The thing that you can't do in this is truly imitate like cereal or ethernet based communication with protocols.

You can imitate like this the sampling behavior that you would see with the measurements. But you can't. So like this simulation is updating rate of like once every ten or fifty micro seconds, and the types of industrial control systems, they may sample the measurements at similar rates or maybe not quite that fast. But the data that's communicated is communicated like once every few seconds in a lot in some cases, a few cases, it might be like 30 messages for a second. And so slowing those down to imitate that behavior. So one option would be using a program like this to simulate some of those conditions and simulate those behaviors. Another one would be working toward something was a remote access to the labs.

#### **8. Do we have access to download this software?**

Yes, I can get you access to this software. We would have to decide which one is the best one to use. This one is nice because it doesn't require the licensing effort. It's very simple. but not the most user friendly. The program is in ECE421. Power world would also be an option for something like this.

#### **9. I think we had installed the power world for the ECE421.**

The problem was ECE421. It's a lot harder to imitate some of these behaviors. It's you would probably need to export things to another program and then take them back and post process them. And so power world can export things into like a matlab file or it's a file that matlab can read would be one option for post processing that and actually it possible it exports to excel. So you could actually program things in excel to do it too.

But it's our limit is a lot more, but it is something that as advantage of this crisis. The people that would be doing this class or seniors or the better chance they may have already learned power world and haven't learned this yet.

I've been talking to another student who's actually developing python version of this program and i'm showing on the screen that's actually more people would be more friendly for this in the long run, but it's not ready yet.

When I run these simulations, this is a case where i'm actually trying to follow a voltage set point. It makes it make a control of voltage. So what i'm doing is controlling a reactive power set point.

Let's see. That's something I want. So do you see the plot with the wave forms or do you see this the panel that I used to select the wave forms? -Just the pane? -Okay. So this is an example of a case where i'm taking control inputs that are making taking a voltage regulator change at set points, and we're causing the reactive power output to change following a system condition.

So this is something where it's a controller for the inverter, which is able to sample at a high rate and respond to the high rate. If we're doing something with a SCADA system, we would be looking at starting from wave forms that our varying versus time. And then they would be sampled and then they would be you would calculate an rms value from them.

So you might be sampling this. If you look at 160 hertz cycle that you might be taking measurements of this 16 times, and then using an algorithm to calculate an rms magnitude and calculate a phase angle compared to some reference.

And that's what a lot of these systems do when they're calculating, when they're measuring voltage or current, they usually want the rms values and they might calculate have meters to calculate real and reactive power.

And so some of that is we can I can give you programs for doing some of this or we could do something like power world to do it and then post process it, closing the loop with power world diversion that we have a accessible for classes doesn't let you close the loop with an external program. They're out on set. You would have to pay for that could do it, but not ones that are free.

**10. Ok, I see ,Thank you. And alsowe check the embassy in shanghai and I don't think I we can make it to Idaho. Perhaps we shall make some modifications of how to proceed the project.**

I think I we definitely need to stick with a project that can and all began remotely for the whole year.

**11. Can you give us some suggestions about what should we do about our design review?**

So in your design review you need like to prepare like weekends we could say like slides using PPT and to talk about your design, your, for example, your simulation, what have you done in your simulation or in your model Specifically. So I think in the time being you don't have like a model that is prepared or have you haven't to prepare your model yet. Right? So, I think you need to have something to show in the presentation. Yeah, so I don't know if you are a they are ready to present something.

**12.I don't think we have much things to show because we only focus on the materials**

The way the design review is supposed to work is that you would be presenting some options for what you're going to do or what you're going to do for implementing your design. Usually you would be presenting this to the sponsor. These are some choices. I know share the screen again and i'm going to share the design review slides from the team last year. So, they started out just giving some general information about themselves. Any that they're going to talk about. So, this is from their wiki page of its presentation design presentation one near the bottom of the winking page. And then they had a little bit of a formatting problem here, but they said this was a goal for the project. And basically, just going through what they're going to do. Their schedule or budget, the things that they've learned as they were doing the team learning part of the learning phase of their project. They look at the labs that the existing labs from ECE544/444 They talked about the challenges. What they did was they presented some options for labs that they could do and how they might implement them. In your case, part of one of your options is going to be are we going to do this in the lab that's done with?

As are we going to do this as a lab that's done with computer simulation? Are you going to do this as a lab like as joe suggested with? We're improving the documentation of the labs from last semester. So, what they did was they went through and presented a series of options. So here they said option A, option B, option C for some different labs they could add. And basically, talked about sort of the strengths and weaknesses of each of the options. And then they were asking for input from the as far as what's option they should choose to go forward with.

**13.And actually I was still confused about the simulation parts. Like you said just now about how can we do it remotely? Could you explain a little more if you don't mind?**

Okay. I'm going to share a different screen for a moment.

So, this is the wiki page from the project last semester. So, they have these different labs they did. So, lab one was basically the students for learning to use this relay and learning to use an interface to connect to it. And so, or remote access to the slab when one way of doing a remote access is basically having somebody who is in the lab connect this have the that's interfacing to this connected to the internet where students could log into it through a vpn so that we can have some control over access and limiting access. And basically go through a series of steps configuring doing the configuration, entering the configurations to program this device. And then be able to have something where we have like an interface for someone could push a button and the interface. And that would start running the experiment. So that would turn the power on for this. It would basically have a button that would close a contact from the computer. And then you can look at the measurements on this. So something like that would be possible through most of these steps, some of the steps like here where they're manually turning the dial on this thing that would be a more difficult thing to do remotely.

It's possible to program a wave form into this, but there are some limits on how remotely accessible this device is. So when I talk to him, what access for that really means is that interacting with a software that's running and controlling these devices remotely. If you're not going to be able to come to campus in the spring, that's that is going to be a harder option to do, but I still think you should present it as and as an option in the design review and talk about of pluses and minuses of that. And one of the minuses is we would also have to have somebody it would be able to be in the lab and that you could have a zoom session with them. And you will be able to talk with them.

#### **14. Who can and What help us? We would need to work with and come up with somebody who would be the local person here would be in the lab to help with us.**

If we went with this option, I will talk to Abdallah and find someone to help you.

And from the class point of view, the other thing that would be a heaven for this is if you have like 5 off campus students in a semester who are doing this especially with zoom where it's easier to have multiple people at once. That's durable. I have some similar stuff that I did for remote access labs for protective relaying class about 12 years ago. My problem was I had one semester I had over 30 students off campus. And you didn't have anything equivalent to zoom then.

And for the students off campus to do things remotely was very hard to have more than one at a time. So, we can only have one at a time. So if we had 30 students that were each doing a lab that took let's just to choose a number, let's say it took an hour. That means the lab is occupied for 30 minutes. That was one of where if we had the power on, we needed a second person in there with the TA for safety protocols. We have to think about the scalability as long as the class is small, it's durable to have these remote labs. I think it's too big that can be a challenge. The simulation would basically do simulations to try to come as close as we can to imitate in the behaviors we would see in these labs that are trying to illustrate the behavior of an industrial control system.

And so that we would want to start out with a waveform that was something that was starting with sinusoidal wave forms and have things that you can cause actions to occur.

And so, there's another program that we would probably be better off having you guys use. It's going to be a little harder for you to install it to run it remotely. But it's one that probably it has a little bit of a user interface to it that has buttons you can push and stuff like that, which will work better to program called pscad ptc. So, I can open an example with that program if it would be useful.

Am I giving it too much at once? Or we could see what we could do is power world too. I think you guys would need to figure out what you could do with power world. I think power world would be harder to do. You can do some sorts of control, but it's harder to illustrate the state of concepts with power world.

**15. Okay, thank you for your time. we really apologize for not attending the meeting on the last week.**