

BACKGROUND

Industrial Control Systems (ICS) are used industry wide to automate and control industrial processes and critical infrastructure. The University of Idaho Electrical and Computer Engineering department is expanding curriculum related to the implementation of ICS. As part of this expansion, the ECE department would like to create laboratory exercises to demonstrate ICS concepts. These exercises would benefit students in the following ways:

- Lab exercises increase the understanding of high-level ICS concepts
- Lab exercises provide experience working with equipment relevant to the industry.
- Engineers entering the industry with equipment experience will start further ahead.

OBJECTIVE

Identify important ICS concepts, create five laboratory exercises to demonstrate the concepts, and provide proper documentation in the form of lab guides.

PROJECT SPECIFICATIONS

Duration	Documentation	Progression	Equipment
Complete in Under 2.5 Hours	TA and Student Lab Guides	Cumulative Lab Progression	Use Existing or Donated Equipment

ACKNOWLEDGEMENTS



Mentor
Hussain Beled



Sponsor
Dr. Brian Johnson



Mentor
Joseph Stanley

PROJECT DEVELOPMENT

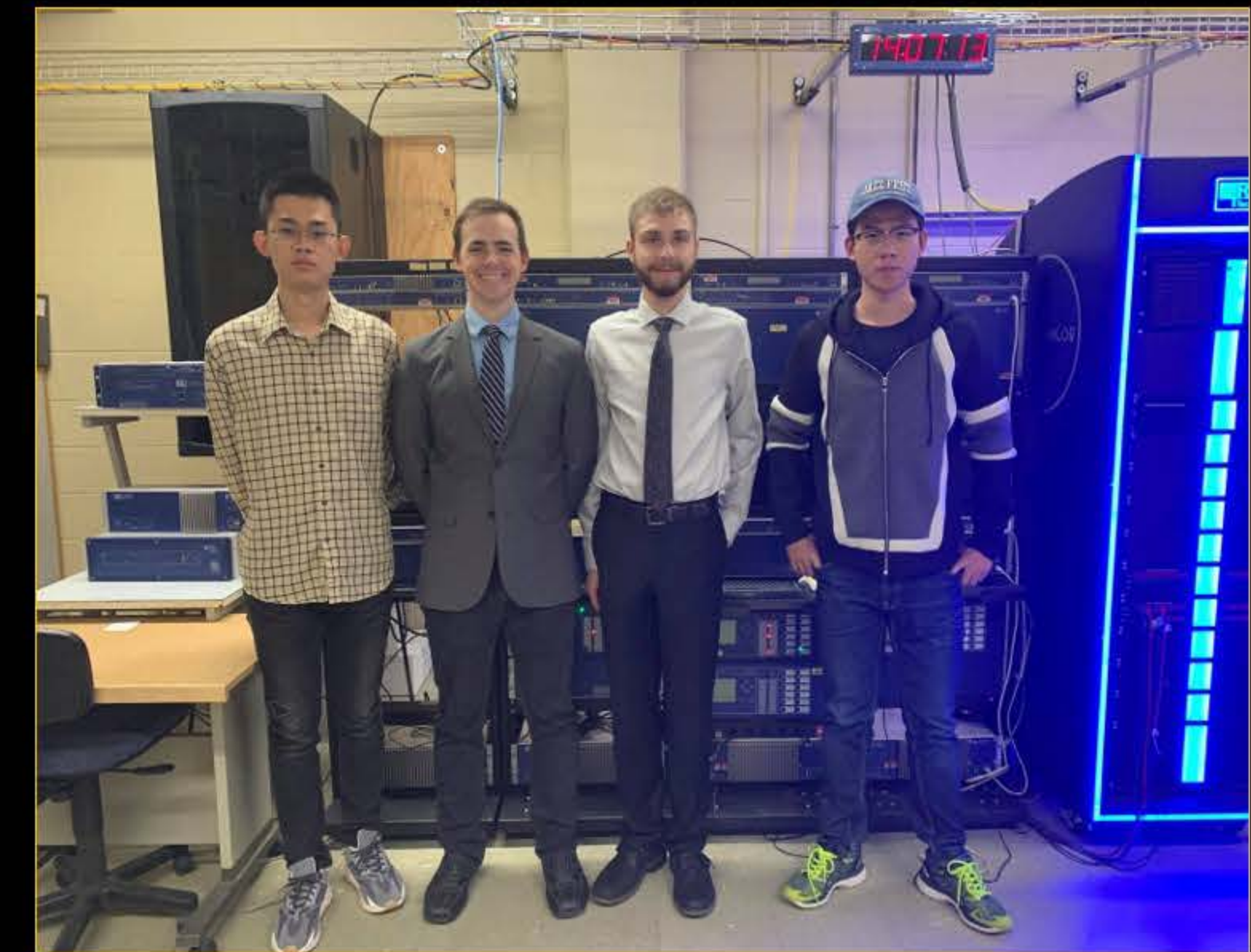
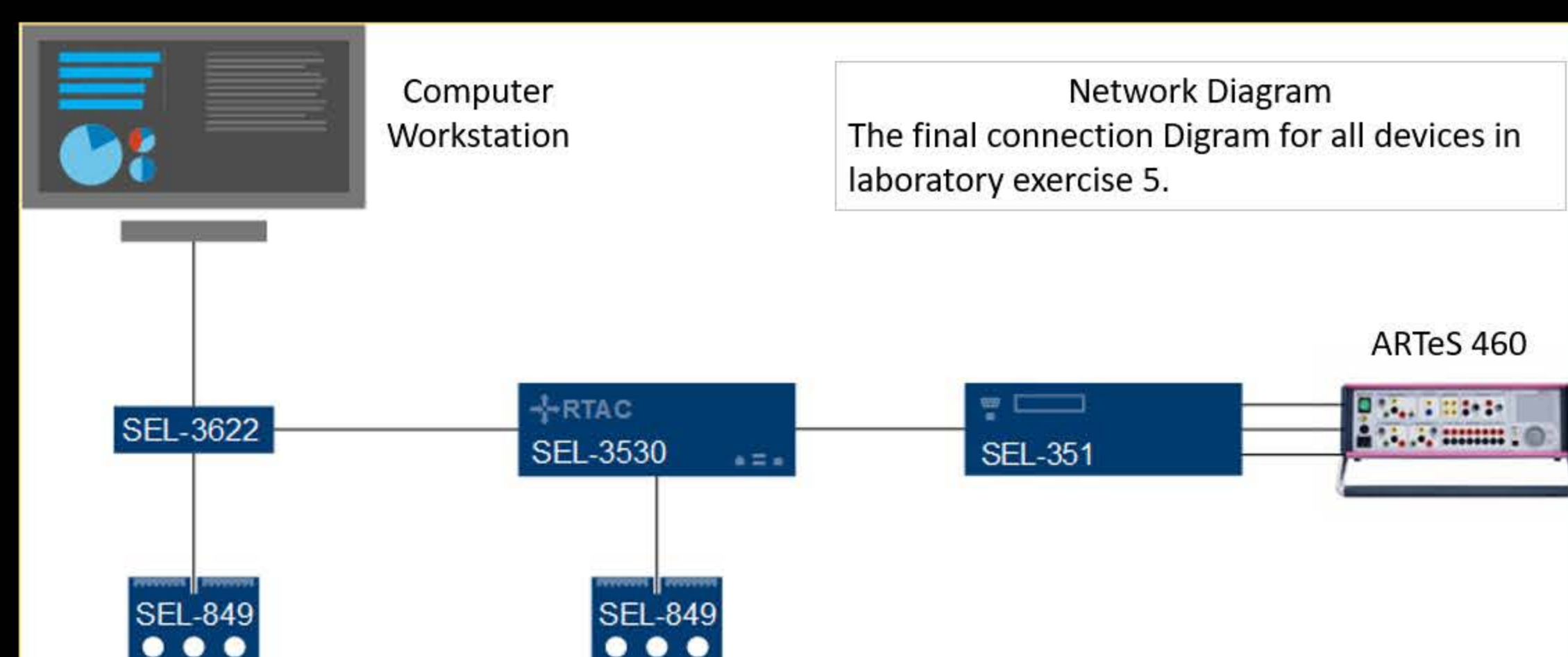
The team began by reviewing existing laboratory exercises for the class ECE 444/544: Supervisory Control and Critical Infrastructure Systems. The team noted the strengths and areas for improvement in the exercises.

The team then identified important ICS concepts by working with project mentors. Mentor Joe Stanley held information sessions to teach the team about operating ICS equipment. The team documented important steps and procedures for use in future lab exercises.

Lab procedures were constructed in the Analog Model Power System Lab. Team members constructed a computer workstation that was used to construct and test lab procedures.

LAB EXERCISE SUMMARIES

Lab Number	Description
1. IEDs	Introduce intelligent electronic devices (IEDs) and methods of interaction.
2. RTUs	Use the SEL RTAC as a Remote Terminal Unit (RTU) to interact and control the SEL-849 Relay.
3. HMI Design	Create a Human Machine Interface (HMI) to display voltage and current measurements from the SEL-849.
4. Commissioning	Practice commissioning a new IED into the existing industrial control system.
5. Cybersecurity	Introduce proxy services and password management.



Team Control Systems
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SEL RTAC atop SEL-351
Team members used the SEL RTAC as an RTU. The device can manage equipment remotely. In Lab 4, the RTAC controls and receives data from the SEL-351 protective relay.



KoCoS ARTes 460
The KoCoS is used to apply voltage and current to devices for accurate measurement and testing.