

# Data Acquisition System for Synchronous Generator Transient Performance - Team PREW Generation

## Meeting Minutes

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*Date:* 9/4/18

*Time:* 3:30PM

*Location:* Vandal Ballroom

*Attendees:* Abdulwahab Aljabrine, Elliott Sher, Roger Xia, Preston Wu

### *Agenda Items:*

1. Exchange contact information
2. Establish team roles
3. Establish team name
4. Pick a weekly meeting time
5. Prepare agenda for first meeting with lead instructor
6. Fill out teaming table
7. Review work with lead instructor

### *Action Items:*

1. Phone numbers and emails exchanged. WhatsApp group created for team discussions.
2. Team roles were chosen as follows:
  - Lead: Wahab
  - Budget: Roger
  - Wiki: Elliott
  - Portfolio: Preston

Wahab will draft a presentation with questions for the first meeting. Elliott will write the minutes and send them to Dr. Hess. Roger will contact Molly about our budget.

3. Team name was not created.
4. Wahab will speak with Dr. Johnson about meeting Thursdays at 1:30PM
5. Another meeting is planned for 9/5/18 at 8:30AM in the ECE lounge to prepare the agenda for the Thursday meeting
6. The teaming table was filled out.
7. Dr. Hess informed us that Dr. Johnson is absent from the ballroom so work was not reviewed.

### *Other Notes:*

- Logbooks will be checked at the next meeting

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*Date:* 9/5/18

*Time:* 8:30AM

*Location:* ECE Lounge

*Attendees:* Wahab Aljabrine, Elliott Sher, Roger Xia, Preston Wu

*Agenda Items:*

1. Create agenda for Thursday meeting with lead instructor
2. Write questions to better understand the project
3. Inspect lab equipment

*Action Items:*

1. Wahab is preparing an agenda and presentation for the Thursday meeting.
2. The team came up with questions to ask Dr. Johnson based on the given information and previous completed research on the project.
3. Lab equipment in the BEL basement was inspected for connections, unknown devices, and more questions were formulated. Pictures were taken for the Thursday presentation.

*Other Notes:*

- Wahab confirmed the meeting time with Dr. Johnson and Hussain.
- Team name was chosen to be "PREW Generation" on WhatsApp.

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*Date:* 9/6/18

*Time:* 1:30PM

*Location:* ECE Conference Room

*Attendees:* Abdulwahab Aljabrine, Elliott Sher, Roger Xia, Preston Wu, Dr. Brian Johnson, Hussain Beleed

*Agenda Items:*

1. Determine the goal of the project
2. Project history
3. Ask questions about equipment
4. Understand motor/generator schematic
5. Client contact information

*Action Items:*

1. Things to measure:
  - Speed
  - Torque
  - Load Phase Angle
  - Terminal current
  - Terminal Voltage
  - Field Current
  - Field voltage
  - Power
2. History: Previous reports can be found on wikis or given by Dr. Johnson. There is a 3rd project on synchronous generators but the poster is not up. Two members of the adjustable governor project work for SEL, Dr. Johnson can give contacts. The encoder can accurately collect frequency, but not phase.
3. Questions:
  - a. Is it necessary to display/store all the data on the HMI & storage? **Different devices measure different things but need to be recorded and time synchronized in the same place. One HMI & Storage.**
  - b. Can the UNITROL1020 calculate speed, terminal voltage, field current, and field voltage? **Question for Norman. Also figure out the sampling rate of the device. Acceptable range is currently unknown.**
    - i. If yes: can The Excitation Control of a Synchronous Generator be used?
    - ii. How accurately was the Adjustable Governor for Synchronous Generator able to calculate instantaneous radial frequency? Can we use their report as well?
  - c. Can the PMU be used to calculate phase load angle? Can we use the grid as a reference angle? **Yes, the PMU can be plugged into the system to**

**synchronize it with the power grid. Two PMUs may be needed at terminals of the grid and the machine and time synchronized.**

- d. Is the battery in the ABB used for excitation? Or does it convert AC to DC? **Uses PWM converter. This is a battery charger from a failed project. Dr. Johnson will give the report from this.**
  - e. What does the device connected to the ABB do? **Field flash used to excite the generator. We can ignore these without disconnecting.**
  - f. What does the gray boxes do? (connected CT) Schematic? **The right box is the power input to the AC drive. Neutral are shorted together (Y-connected). Rated current of 54A. Discreet parallel loads are used to simulate difficult faults. The left box connects overhead to the model power system to synchronize the generator to the grid. Keep model power system below 5-10A. Need to use load banks to test with higher current, unconnected to the system.**
4. Can we have a schematic of the whole system? **Gone over in parts.**
  5. How often to contact Norman Fischer? **Johnson meets him 9/7, will appoint a contact person for our budget. Keep in contact with someone at SEL regularly. Norman will ask difficult questions at the design review.**

*Other Notes:*

- How often to email minutes?
- Logbooks checked?
- SAPA agreements submitted
- Team contract?
- Extra contact person: Andy Miles, Roger
- National Instruments has software for data acquisition. Installed on computer in GJ 208 lab
- Coordinate with department technician (Mike) for use of a load bank.
- Can most likely meet at the same time next week.

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*Date:* 9/13/18

*Time:* 1:30PM

*Location:* ECE Conference Room

*Attendees:* Abdulwahab Aljabrine, Elliott Sher, Roger Xia, Preston Wu, Dr. Brian Johnson, Hussain Beleed, Dr. Feng Li

*Agenda Items:*

1. Last meeting discussion
2. Project status
3. Topology of system

*Action Items:*

1. ABB UNITROL 1020
  - Can't be used to acquire data
2. The range of acceptable sampling rate
  - 10kHz sampling
3. Access to GJ 208 Lab
  - Vandal card reader, talk to Dr. Hess
4. Documents relevant to project
5. Contact info of Andy Miles & Rogu
6. Learning about SEL 487E, 3530
7. Searching for GUI software
  - SEL Synchrowave Central, check max sampling rate support
  - Clearview - designed for SCADA, not our sampling rate
  - Labview, university has license
8. Learning about VFD project to measure torque and speed

*Other Notes:*

- Rogu is the SEL point of contact
- Norman does not want existing relay or ABB
- Wants a single data recorder getting all measurements
- Files in IEEE comtrade format preferred
- Check out Microsoft Project
- Budget: Come up with some reasonable options for data acquisition boards
- Figure out what we have already in GJ 208

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*Date:* 9/20/18

*Time:* 1:30PM

*Location:* ECE Conference Room

*Attendees:* Abdulwahab Aljabrine, Elliott Sher, Roger Xia, Preston Wu, Dr. Brian Johnson, Hussain Beled

*Agenda Items:*

1. Last meeting discussion
2. Progress this week
3. Specification of data acquisition device
4. Next week tasks

*Action Items:*

1. We checked the GJ208 lab
  - Only one device might work
2. Might be able to get a microsoft project license from the department
3. Talk to Dr. Hess about Labview CD
4. Went over budget estimation
5. The design review in the fall will have a more finalized budget
6. PXI 6251 in 208 lab
  - Doesn't mention sampling all devices at same rate
  - Would need extra hardware to sync multiple devices
7. USB 6356
  - Limited to voltage inputs
  - Maybe use shunt resistor
    - We have high precision resistors somewhere
    - They are metal bars attached to wood
8. NI USB 9218
  - Only 2 inputs, might need multiple devices and synchronized together
9. How does the encoder work?
  - Talk to Chad
  - Andi is expecting to hear from us too
    - Might know where encoder data sheet is

*Other Notes:*

- Current lamps are sitting around somewhere
- Roju should be back in Pullman now

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*Date:* 9/27/18

*Time:* 1:30PM

*Location:* ECE Conference Room

*Attendees:* Abdulwahab Aljabrine, Elliott Sher, Roger Xia, Preston Wu, Dr. Brian Johnson, Hussain Beleed, Roju, Andy Miles

*Agenda Items:*

1. Project Specification
  - Data Acquisition Device Specification
  - Measurement Specification
2. Methodology
3. Current & Voltage LEMs

*Action Items:*

1. PXI 6251
  - Can't send all channels at the same clock rate, multiplexed
2. USB 6356
  - Only accepts voltage input
3. NI USB 9218
  - Only 2 inputs, would need multiple devices
4. Measurement
  - Use line to ground, generator neutral
  - Max Voltage/Current AC/DC
    - 230V L-L terminal, L-N can be full voltage, not divided by root(3)
    - DC - ABB datasheet
  - Measure all 3 L-N
5. Current LEM
  - Dr. Johnson might have schematic
  - What is the capacitor for?
    - Need DC as reference
  - Might be able to buy 3

*Other Notes:*

- We can measure the flux in the machine, there are flux probes
- Want to measure phase angle from the encoder
  - Something to ask Chad
- Find time sampling window for USB 6356
- Are the cables electromagnetic induction free?
  - How to mitigate this? Shield cables? Ask Chad
  - Check the casing on the PXI 625
  - Might need new torque transistor, encoder

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*Date:* 10/4/18

*Time:* 1:30PM

*Location:* BEL G10

*Attendees:* Abdulwahab Aljabrine, Elliott Sher, Roger Xia, Preston Wu, Dr. Brian Johnson, Hussain Beleed, Andy Miles, Roju, Harry

*Agenda Items:*

1. Project status
2. Topology
3. Next week tasks

*Action Items:*

1. We found a d sub connector cable we can use, takes 16 analogue or 8 differential
2. Offline and online LEMs
  - Need to test the LEMs
  - Roju wants to push the current limits of the model power system
  - Idaho Power says the model power lines are rated 20A
  - Rack only accepts voltage inputs
    - We first thought we would use a shunt resistor
  - Stator current may need to be 100A
    - Need to find the ratings of the model power before picking shunt resistors
  - We can purchase a new encoder
3. Next week test DC voltage into the chassis if we can get the computer installed in the lab

*Other Notes:*

- Find out how to use the microcontroller at the same time as the ABB exciter from Chad
- 2 LEM boxes combined, A/B/GND and C/N/GND



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*Date:* 10/11/18

*Time:* 1:30PM

*Location:* ECE Conference Room

*Attendees:* Abdulwahab Aljabrine, Elliott Sher, Roger Xia, Preston Wu, Dr. Brian Johnson, Hussain Beleed, Andy Miles

*Agenda Items:*

1. Project Status
2. LEM Testing
3. Termination Accessory

*Action Items:*

1. Installed Labview and computer in lab, snapshot, and LEM testing
2. LEM measurement is confusing
  - Is it measuring current or voltage?
  - We came up with equations
3. Screw Terminal Block
  - Few hundred dollars
  - Shielded connection from rack to port

*Other Notes:*

- Create a list of questions and things we need for Roju
- Might need to request facility to do wiring in the lab room
- Can get cabling from G10 or Mike's shop, rating will be on the cable
- Need to design a 3rd box for DC measurement, maybe 4th
- Have the measurement interface and some of the measurement done by the end of the semester
- We can test with the generator and bank next week
- Coordinate 3 phase bank use with 420 TAs
- Do a 0 current LEM measurement to find offset with the generator

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*Date:* 10/18/18

*Time:* 1:30PM

*Location:* ECE Conference Room

*Attendees:* Abdulwahab Aljabrine, Elliott Sher, Roger Xia, Preston Wu, Dr. Brian Johnson, Hussain Beleed, Andy Miles

*Agenda Items:*

1. LEM Testing w/ AC
2. Encoder
3. Termination Accessory

*Action Items:*

1. How does Chad's code work for the encoder
  - Will the fixed 16ms offset drift the values?
  - How does it calculate a single 0 crossing from 3 values?
  - Roju can buy the termination accessory next week

*Other Notes:*

- Look at torque transducer in lab, might need to be updated
- Dr. Johnson will be busy the next 3 weeks

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*Date:* 10/25/18

*Time:* 1:30PM

*Location:* ECE Conference Room

*Attendees:* Abdulwahab Aljabrine, Elliott Sher, Roger Xia, Preston Wu, Dr. Brian Johnson, Hussain Beleed, Andy Miles

*Agenda Items:*

1. Measuring the load angle
2. LEM box reverse engineer
3. Design DC LEM box, print pcb
4. Test PXI 6251

*Action Items:*

1. Why did Chad not use a filter?
  - His plan was only for data collection, not analysis
2. Why half wave rectification?
  - Might just be a measurement specification
3. L-L measurements are likely not as high priority
4. Found another termination box to test PXI (unshielded)
5. Need to make sure the PXI is not multiplexing the samples together at a lesser sample rate

*Other Notes:*

- Can the national instruments box do the job of the microcontroller?
- Does Norman want measurements off the physical rotor position or off the electrical part?

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*Date:* 10/30/18

*Time:* 5:00PM

*Location:* NASA Conference Room

*Attendees:* Abdulwahab Aljabrine, Elliott Sher, Roger Xia, Preston Wu, Dr. Brian Johnson, Hussain Beleed, Andy Miles, Raju, Dr. Normann Fisher, Dr. Feng Li, Dr. Yacine C

*Agenda Items:*

1. Project specifications, constraints, and deliverables
2. Project learning
3. Project topology
4. Project cost estimation
5. Project schedule
6. Potential problems

*Action Items:*

1. Need data acquisition board meeting sampling requirements and a step down sensor
2. We already have the PXI 6251
3. Two topologies, one with 17 analogue with no microcontroller and an incremental encoder, one with 11 analogue and no microcontroller
4. AC/DC LEM voltage and current test results

*Other Notes:*

- Pay attention to polarities on LEM boxes
- LEM might give too small of an input to read on the data acquisition board
- Check if the LEM will output too high of a voltage too
- Going to need to higher resolution, effective bits, for the LEMs
- Noise on the A to D converter
- Use VT for the AC voltage
- Use CT for the DC
- Find instrument transformers to take 180V to within 10
- Understand how LEMs work in 2 weeks and why they are not perfect
- Keep LEMs for the DC, low magnetizing current (negligible)
- No ripple in the DC
- Want the machine to not go out of step, but be stable
- $PE = PM + Losses$
- Find effective number of bits
- Find of the A to D clips the waveform
- Know how the torque transducer works
- Know how the angle encoder works
- Have a load bank with small increments, fine steps