EECS LAB SAFETY IN-SERVICE DAY

AUGUST 22, 2022

Welcome and thank you for attending!

SAFETY/EMERGENCY CONTACT INFORMATION

- Lab door safety placard contacts which include phone numbers for:
  - Primary Contact - Principal Investigator (PI) responsible for lab
  - Secondary contact responsible for lab
  - Department Safety Officer
  - Department Head
  - Emergency numbers e.g.,
    - Police/Fire/Medical: 911
    - UT Police: 974-3111
    - Environmental Health & Safety (EHS) 974-5084
    - Facilities Services 946-7777
- Robert B. Martin – EECS Laboratory Safety Advocate (LSA)
  - Email: rmarti47@utk.edu
  - Phone: Office – (865) 974-9023, Cell – (865) 771-3694

IMPORTANCE OF SAFETY

- Unsafe work practices can and do impact everyone working at UT
- Hazards can have serious consequences
  - Death, short and long term health conditions
  - Property damage to buildings and equipment
  - Funding loss
  - Short and long term shut down of operations
  - Increased short and long term costs

FEDERAL, STATE & LOCAL SAFETY REQUIREMENTS

- Occupational Safety and Health Administration (OSHA & TOSHA)
  - Requires all employers to provide a safe work environment
  - Requires all employees to be trained in and implement safety in the work environment
- National Fire Protection Association
  - National Electrical Code (NEC)
  - NFPA 70E – Standard for Electrical Safety in the Workplace
  - Building Codes
- OSHA and TOSHA inspectors
- State Fire Marshal
- Local Building Inspectors

SAFETY IS EVERYONE'S RESPONSIBILITY

- Safety shall be considered and implemented at every step of the way
  - Individual daily actions
  - Designs - protections
  - Experiments
    - Test set-ups
    - Test procedures
    - Personal Protective Equipment (PPE)
  - Lab & public spaces
  - Environmental impacts due to:
    - Radiation
    - Biological
    - Chemicals

RISK CONTROL

- As engineers, each of us should carefully consider the following in relation to the lab situation you're in
- Risk control hierarchy – in order from best to worst
  - Eliminate the risk to make it go away – Best solution
  - Substitution to eliminate or reduce the risk – Change process, procedure, design
  - Isolation to separate the risk from personnel – Barriers, shields, etc.
  - Engineering controls to reduce the risk – circuit protection, Ground Fault Circuit Interrupter (GFCI), Arc Fault Circuit Interrupter (AFCI), Arc Flash Detector, interlocks, etc.
  - Administrative controls to lessen the risk by increasing personnel awareness – signs, training, reviews, policies, procedures, etc.
  - Personal protective equipment (PPE) – Last resort
- Most people think PPE is the starting point for safety, it's not and we need to rethink

SAFETY TRAINING

- Everyone is required to be trained including:
  - Faculty
  - Staff
  - Students
  - Visiting personnel using our space
- Training records must be maintained and available for 15 years
- Online Training Platforms
  - K@TE – Managed by UT Human Resources
    - Access at https://kate.tennessee.edu/ under Health, Safety & Emergency Preparedness grouping
    - For full time University employees both faculty & staff
    - Records training results for individual
    - Maintains record in IRIS for documentation requirement
  - Canvas
    - Access at https://utk.instructure.com/ Under Courses, All Courses, Environmental Health & Safety
    - For Everyone with a UT log-in
    - Records training results for individual
    - Record of training must be printed out and saved in file for documentation requirement

TRAINING REQUIREMENTS

- Basic training everyone must take yearly
  - Hazardous Waste (Canvas)
  - Hazard Communication and General Health Safety Updates (Canvas)
  - Fire Extinguisher Training (Canvas)
  - Personal Protective Equipment (Canvas)

GENERAL LAB TRAINING

- This training should be taken by all lab users
  - General Lab Safety (Canvas)
  - Fire Safety in Laboratories (Canvas)
  - Personal Protective Equipment (Canvas)
  - Electrical Safety Orientation Level (Canvas)

SPECIALIZED LAB TRAINING

- Additional training that may be required depending on the situation
  - Chemical Fume Hood Safety Training (Canvas)
  - Compressed Gas Cylinder Training (Canvas)
  - Laboratory Safety for Undergraduates and Minors (Canvas)
  - Lead Awareness Training (Canvas)
  - Hot Work (Canvas)
  - Equipment or Machine Tool Use (Personal Instruction)
  - Lockout/Tagout (Personal Instruction)
  - CPR/AED/1st Aid (Classroom) – Provided by outside organizations & requires funding

BEST LAB PRACTICES

- Keep your work area clean and organized
  - Place instruments on bench shelves if possible
  - Place large power supplies next to bench instead of aisles
  - Protect personnel from touching burn hazards, i.e. soldering irons, heat guns, load resistors, etc.
  - Neatly arrange wiring to minimize chance of entanglement. Route power wiring to side or back of bench, not hanging over front.
  - Check for & remove unnecessary items from around the test set up like, tools, paper, wire, fasteners, etc.
- Use terminal shields and equipment guards to prevent touching and shorting
- Check connections to make sure they are tight
- Use safety shields on benches and wear proper PPE for task
- Throw away trash, shipping containers/packing materials, etc.
- Keep aisles clear of instruments, power supplies, boxes, wires, cables & trip hazards
- Never run experimental circuits unattended without prior approval and protections in place

BEST LAB PRACTICES (CONTINUED)

- Always have a second person present when running live experiments above 50 V
- Always verify that the conductor used (wire, cords, cable) is rated for your intended application.
- Always shut down power before making any changes to the test set-up including moving components, probes, etc.
- Dress appropriately
  - Remove jewelry (rings, necklaces)
  - Don't wear shorts & open shoes when soldering
  - Don't wear synthetic fabrics if Arc Flash hazard exists
- Conduct a hazard analysis of the test set-up prior to first use
- Perform an Arc Flash calculation to understand the Arc Flash risk for any experimental testing above 100 V
- Generate a step by step test procedure and follow it
- Do your homework. You'll be surprised what safety information is in equipment manuals, Safety Data Sheets, etc.
- Never float or disable safety grounds
- Never cut corners and jeopardize safety

RESOURCES & LINKS FOR SAFETY INFORMATION

- Occupational Safety and Health Administration (OSHA) - https://www.osha.gov/
- National Electrical Code (NEC) - https://www.nfpa.org/
- National Fire Protection Association (NFPA) 70E - https://www.nfpa.org/
- UT Environmental Health and Safety - https://ehs.utk.edu/
- CURENT Lab Community Action Plan - https://wiki.curent.utk.edu/

INFO SPECIFIC TO CURENT LABS

- Safety Requirements are identified in CURENT Student WIKI - https://wiki.curent.utk.edu/
  - Safety Training Requirements
    - All personnel must take training prior to getting lab access
    - Personnel must retake the following training yearly to retain their lab access
      - Hazardous Waste (Canvas)
      - Hazard Communication and General Health Safety Updates (Canvas)
      - Fire Extinguisher Training (Canvas)
      - Personal Protective Equipment (Canvas)
  - Safety Policy - CURENT Lab Community Action Plan
  - Lockout Procedure
  - Energy Control Procedure form
  - Project Definition form

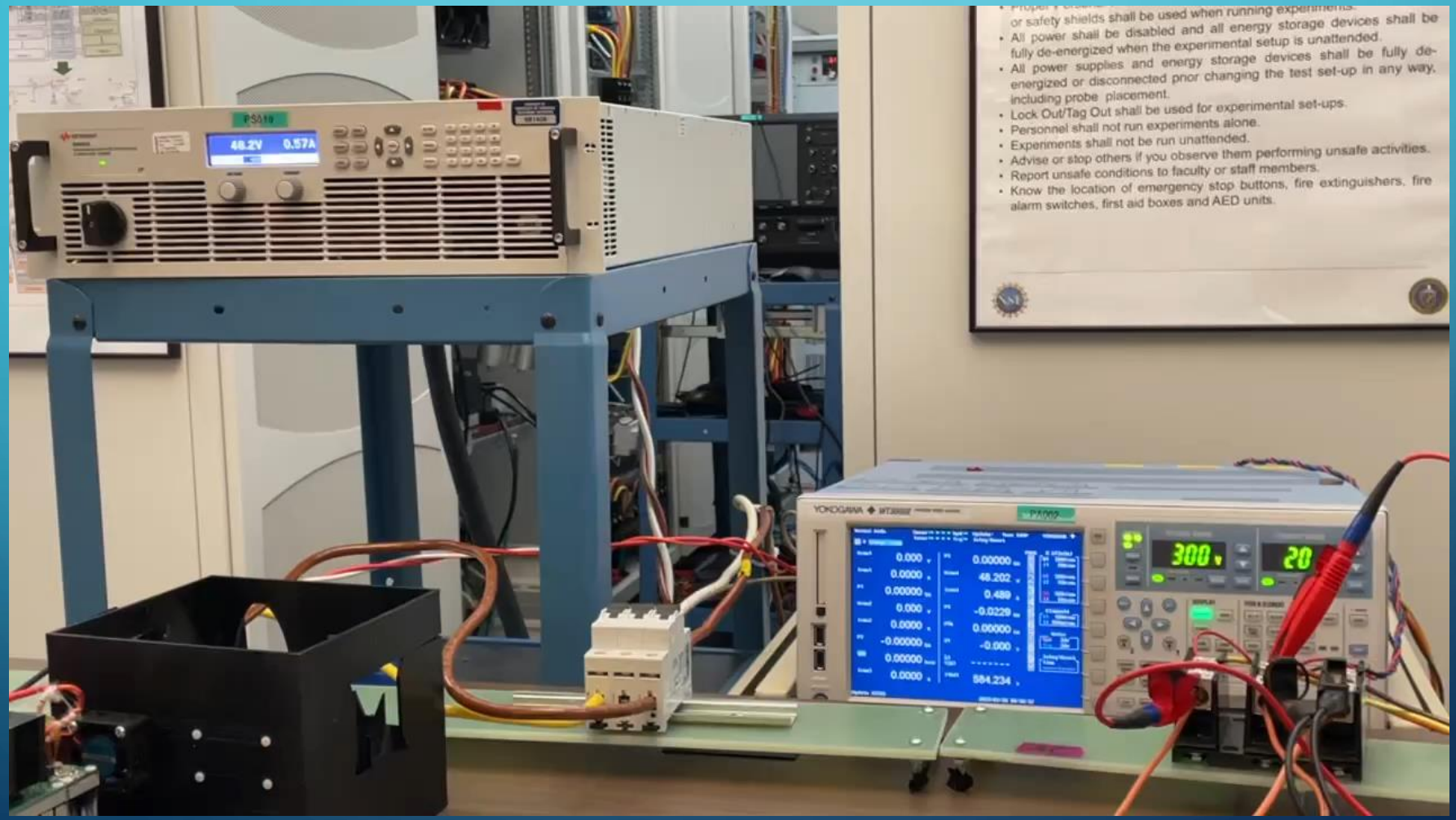
COMPLIANCE REQUIREMENTS

- All personnel using the labs are required to comply with all safety policies and procedures
- Quarterly Reviews will now take place to evaluate compliance requirements
- Lockout Procedure – must be followed for all work on circuits >50 V
- Energy Control Procedure form –must be filled out for all experimental circuits
- Project Definition form – Everyone must fill out this form for any lab activity > 50 V

TEST PROCEDURES

- Generated by designer of the circuit/experiment
- Reviewed by lab manager and advisor or Principle Investigator (PI)
- Required for all experiments operating at > 50 V
- May be simple for one source experimental set-ups with one user
- Will be more complicated for multiple source experimental set-ups or multiple users
- Provides personnel with insight into safety issues which may be encountered during testing
- Plans for and documents responses needed in the event of a hazardous condition occurring

208 V, 1 KW, ARC FAULT EVENT IN CURENT LAB



DAMAGED TABLE CORDS

COMMON SAFETY ISSUES

- Blocking aisles and egress with equipment and boxes
- Daisy chaining power strips
- Improperly tightened connections
- Improper wire or cable used
- Trip hazards e.g., wires on floors, boxes and other items left on floor
- Items placed blocking access to electrical panels, <36 inches front clearance
- Safety covers and panels removed from equipment
- MSDS or SDS not made available or utilized by personnel

THE THINGS I'VE SEEN & HEARD

- Disabled safety interlock nearly killed person – RADAR
- Working alone – Caught up in 120V circuit @ 2AM
- Fooling around can kill someone – 1" Rod through two walls
- The unexpected – 10V Power Supply on top of 208V converter
- The risk of probing live circuits – Prius battery pack short
- Doing stupid things – Stripped wires plugged into electrical outlets
- Disabling grounds – Modified power strip/cheater plugs
- Not knowing & not asking – Student drilling with no bit in the drill chuck

Feedback?

Suggestions?