

30TH ANNUAL

HANDS-ON Relay School

MARCH 11-15, 2013



**WASHINGTON STATE UNIVERSITY
PULLMAN, WASHINGTON**

SPONSORED BY:

Western Energy Institute | Washington State University

ONE WEEK FOR ONLY \$625

Applications Accepted November 1, 2012 – January 25, 2013



CONFERENCE MANAGEMENT

30TH ANNUAL

HANDS-ON Relay School

“I learned more in one week at Hands-On Relay School than all year elsewhere. Great school—could not survive well without it.”

“Where else can you get this level of hands-on real world testing experience?”

“A tremendous value for the cost of the school; the most productive week—educationally speaking—I have had.”



CONFERENCE MANAGEMENT

OBJECTIVES OF THE HANDS-ON RELAY SCHOOL

The Hands-On Relay School is a professional development short course to train protective relay technicians, electrical/power plant technicians, engineers, and protective relay test specialists.

Students are enrolled in one of seven tracks for the duration of the school.

- Basic
- Distribution
- Transmission
- Generation
- Electromechanical
- Automated Relay Testing
- Theory

Students participating in these tracks will:

- Become familiar with manual or automated test methods for a variety of protective relays and test equipment.
- Gain valuable knowledge relating to relay applications and operating characteristics.
- Exchange ideas and resolve problems in an open forum.
- Learn preventative and corrective maintenance methods.

Application

School enrollment is limited, and priority is given to organizations providing Lab Facilitators, Lecturers, Steering Committee support, and Western Energy Institute member utilities. Refer to important application and enrollment procedures at the rear of this brochure.

Call for Lab Facilitators

If you are an experienced relay technician who is willing to share your knowledge with others, you can attend the Hands-On Relay School as a lab facilitator. Lab facilitators work with groups of three students in the hands-on labs testing relays and may attend all classroom lectures and school activities. Lab facilitators are not required to pay the application fee and their company receives priority points for students applying for the school. If you are interested, contact WSU Conference Management at **800-942-4978** or **509-335-3530**.

BASIC TRACK

This track is for those students who wish to focus on the calibration, maintenance, testing, and understanding of basic relays. The selection of relays may include overcurrent, differential, reclosing, voltage, or frequency relays. This track is an excellent choice for beginning technicians. [48 students maximum]

Students in this track will:

- Attend the "Introduction to System Protection" lecture series.
- Choose four Concurrent Open Lectures to attend.
- Attend the Friday Panel Discussion and Feature Presentations.
- Wire an overcurrent and a reclosing relay to a breaker simulator to test and troubleshoot an entire protection circuit.
- Perform hands-on testing in the lab on the following relays:

ABB:	RC, IRD9, CA
Basler:	BE1-810/U, BEI-50BF
GE:	IAC53, BDD
SEL:	551

Introduction to System Protection Lecture Series

This lecture series is for beginning relay technicians, newcomers to the relaying field, or anyone who needs the basics. We start with the very basics of relaying to provide a foundation of knowledge upon which to build. The closest thing to "Relaying for Dummies" that Hands-On Relay School has to offer! Taught by experienced utility personnel, this lecture series will be presented on **Monday only** from **7:45am – 3:00pm**.

Topics include:

- Introduction to Protection Basics and Terminology; *Jon Daume, BPA Retired*
- Introduction to CT Basics and Testing; *Steve Laslo, Bonneville Power Administration*
- Introduction to Substation Print Reading; *Jeff Marsh, Avista*
- Introduction to Troubleshooting; *Paul Luther, Puget Sound Energy*

DISTRIBUTION TRACK

This track is for those students who wish to focus on the testing and understanding of multifunction microprocessor relays and recloser controllers used for distribution protection. The selection of relays may include overcurrent, transformer differential, reclosing, synch-check, and frequency protection. This track does not cover electromechanical relays or relay fundamentals. [18 students maximum] [Laptop Computer Required]

Students in this track will:

- Attend the "Distribution Overview" lecture.
- Choose six Concurrent Open Lectures to attend.
- Attend the Friday Panel Discussion and Feature Presentations.
- Perform hands-on testing in the lab on the following relays:

ABB:	REF615
Basler:	BE1-11F
Cooper:	Form 6
GE:	F60
SEL:	751A, 587

Distribution Protection Overview Lecture

Mike Diedesch and Kevin Damron, Avista, Spokane, WA

This lecture will review fundamental principles of distribution system protection, including IEEE device designations, fault current calculations, coordination of overcurrent protection, and reclosing schemes.



TRANSMISSION TRACK

This track features both electromechanical and microprocessor-based multi-function relays used for protection of transmission equipment, including distance and line current differential protection.

[24 students maximum] [Laptop Computer Required]

Students in this track will:

- Attend the "Transmission Overview" lecture.
- Choose six Concurrent Open Lectures to attend.
- Attend the Friday Panel Discussion and Feature Presentations.
- Perform hands-on testing in the lab on the following relays:

ABB:	KD-10
Schneider Electric:	P546
RFL:	GARD 8K
SEL:	421
GE:	L90

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Transmission Protection Overview Lecture

Steven Chase, SEL, Pullman, WA

This lecture will review fundamental principles of transmission line protection. Concepts of distance protection, directional overcurrent, line differential, and pilot protection schemes will be discussed.



GENERATION TRACK

This track features multifunction microprocessor relays used for transformer and generator differential, over-excitation, stator ground, reverse power, synch-check, negative sequence, and loss of field protection of generators.

[18 students maximum] [Laptop Computer Required]

Students in this track will:

- Attend the "Generation Protection Overview" lecture.
- Choose six Concurrent Open Lectures to attend.
- Attend the Friday Panel Discussion and Feature Presentations.
- Perform hands-on testing in the lab on the following relays:

ABB:	REG650
Beckwith:	3425A
GE:	G60, CEH51
SEL:	700G

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Generation Protection Theory and Application

Rogério Scharlach, SEL, Pullman, WA

This lecture will review fundamental principles of generation protection theory and application with a focus on industry standards and best practices.



ELECTROMECHANICAL TRACK

This track focuses exclusively on electromechanical relays used for line, bus, transformer, or generator protection. More hands-on effort is spent on troubleshooting relay problems, calibrating relays, repairing relays, and verifying results. [12 students maximum]

Prerequisite: Basic track or related experience.

Students in this track will:

- Attend their choice of Distribution, Transmission, or Generation Protection Overview lecture.
- Choose six Concurrent Open Lectures to attend.
- Attend the Friday Panel Discussion and Feature Presentations.
- Perform hands-on testing in the lab on the following relays:
ABB: HU, KD-10, IRD9, KLF
GE: CEB52, GSY51, CEX57



AUTOMATED TESTING TRACK

This track is intended for technicians who already understand relay operating principals, have experience in manual testing, and are ready to learn automated testing methods. [student maximum varies]

Note: This track is NOT recommended for those relay technicians who are just starting out. The emphasis of this track is on the test equipment and software, not on the relays. The hands-on labs are taught by the test equipment and software manufacturers, not by the relay manufacturers.

Prerequisite: Experience in manual relay testing and computer use. A laptop computer will be used to communicate with the relays and/or the test set. All students must have administrative rights to their laptop, with the appropriate software pre-loaded.

Students in this track will:

- Attend an Overview Lecture provided by the Test Equipment or Software Manufacturer.
- Choose six Concurrent Open Lectures to attend.
- Attend the Friday Panel Discussion and Feature Presentations.
- Perform hands-on testing in the lab using one of the following testing software programs:
Doble ProTest
Enoserv RTS
Manta Test Systems
Megger AVTS
Omicron

Some test software vendors will offer both a Beginning and an Advanced section, depending on enrollment and skill level of the students. Beginning automated testing still requires a prerequisite understanding of manual testing.

THEORY TRACK

This track provides more in-depth training on protective relays and their associated roles in a power system. This track will not include any hands-on training with relays, but will include some hands-on use of your laptop to test RS-232 and modern communication.

Emphasis this year will be on Communications concepts and applications.

Note: The theory track is for the journeyman relay technician and relay engineer. It is NOT recommended for those relay technicians who are just starting out. Instructors and lecturers for the theory track are considered to be experts in their field. Students are expected to bring their own laptop PC with administrative privileges over the operating system sufficient to load vendor software and allow running of JAVA based applications.

Students in this track will:

- Attend the "Theory Communications" lecture.
- Choose six Concurrent Open Lectures to attend.
- Attend the Monday and Tuesday PM and all day Wednesday and Thursday Lectures.
- Attend the Friday Panel Discussion and Feature Presentations.
- Attend the advanced topic lectures on the following page.

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IP Based Data Communication Networks

Joe Andres, Bonneville Power Administration

Topics covered are the OSI model, hubs, switches, and routers. The students will trace a packets journey across a local and wide area network.

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Phasor Measurement Units

Anurag Srivastava, Washington State University

An introductory lecture of what a Phasor Measurement Unit (PMU) is and how they are implemented to gather and synchronize AC information over large areas.

THEORY TRACK

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Teleprotection Schemes and Equipment

Jim Ebrecht, RFL

A look at communication aided protection schemes and the equipment that makes it possible.

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RS-232 Standard, Modems and PSTN Connectivity

Caitlin Martin & Karin Butler, Bonneville Power Administration

This class will cover both the RS-232 standard used in relay communications and modems used on Public Switched Telephone Networks. In the RS-232 section, students will learn about the standard, handshaking, and basic troubleshooting techniques. Students are encouraged to bring their own RS-232 Breakout box if they have one available. In the modems section, students will learn about the Hayes command set, initialization strings, and flow control modem troubleshooting. There will be a demonstration of telephone connectivity via a line sharing switch and polling controller.

Please note: Includes hands-on exercises requiring students to bring their own laptop PC.

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Synchronous Optical Networks

TBD

Lecture covers Synchronous Optical NETWORKing (SONET), how it used by utilities, and how it differs from asynchronous IP based communications.

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IEC 61850

Eric Udren, Quanta Technology

An introduction to the substation automation and control standard IEC 61850. This standard utilizes Ethernet and IP based communications to facilitate virtual control circuits, event reporting, and transmission of digitized AC quantities.

CONCURRENT OPEN LECTURES

The Hands-On Relay School offers twelve lectures on a wide range of topics relevant to the trade. Each lecture is one hour long and given a total of three times. Students can attend up to six lectures of their choosing.

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Calculating Voltage and Currents for Dynamic Testing

Jammie Lee, Megger, Dallas, TX

Being able to maintain a constant source impedance while testing distance relays makes it possible for relay technicians to mimic real world conditions experienced by the transmission system. This lecture will cover how to calculate appropriate test voltages and currents to maintain a constant source impedance seen by the relay.

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CT Safety

Steve Laslo, Bonneville Power Administration, Vancouver, WA

Opening an energized current transformer (CT) secondary can result in very hazardous voltages and possible damage to the CT. This is a discussion of how a CT can generate high voltages, some video demonstrations of an open CT secondary, and suggested work practices to safely work on current transformer secondaries.

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Distance Relays 101

Jon Daume, Retired BPA, Marysville, OH

This lecture looks at the history of distance relays, how they work, the fundamentals of reach, and zones of protection. Sprinkled with Jon's humor and unique approach to explaining things.

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End-to-End Testing

Chris Werstiuk, Manta Test Systems, Mississauga, ON

End-to-end testing is considered the ultimate dynamic test for any protective relay scheme using communications assisted tripping and can seem like a daunting task. This lecture will walk through a process for a typical end-to-end test to demystify the test.

CONCURRENT OPEN LECTURES

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Fiber Optics for Protection

Chris Dinwoodie, Corning, CA

Fiber Optical Communication networks are replacing many leased line and microwave communication links for tele-protection. This lecture will explain the basic of fiber communications, dedicated and multiplexed systems, and the advantages of fiber over existing schemes for protection.

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Implementing NERC PRC-005-02 Standard

Eric Udren, Quanta Technology, Pittsburgh, PA

The NERC Drafting Team has just developed the new PRC-005-2 Protection System Maintenance Standard, with specific requirements for maintenance activities and maximum time intervals. This lecture will discuss the new requirements and also new options for system maintenance programs.

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Phasor Diagrams

Ron Alexander, Bonneville Power Administration, Richland, WA

Phasors are the universal language of system protection technicians and engineers. This lecture emphasizes the need for a basic knowledge of phasor diagrams and their use in understanding the power system. Topics include load flow phasor analysis, fault phasor analysis, and using Phasors to determine the phase angle across delta-wye transformers banks.

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Substation Commissioning

Greg Butler, Bonneville Power Administration, Vancouver, WA

An overview of typical testing encountered during substation commissioning including test criteria, procedures and techniques, documentation, and safety considerations. Common power system components include transformers, power circuit breakers, reactive equipment, and protective relays.

CONCURRENT OPEN LECTURES

Symmetrical Components 1

Stephen Marx, Bonneville Power Administration, Idaho Falls, ID

Basic principles of symmetrical components with explanation of phasors, per unit system, and symmetrical component equations using sequence networks. Suggested prerequisite for Symmetrical Component 2 class.

Symmetrical Components 2

Stephen Marx, Bonneville Power Administration, Idaho Falls, ID

Analysis of power system elements with symmetrical components sequence network and network connections for each power system fault types. Samples of protective relay applications using symmetrical component method. Highly suggested to attend Sym. Comp. 1 lecture previously.

Remedial Action & Transfer Trip Schemes

Brant Heap, Salt River Project, Phoenix, AZ

Remedial Action Schemes, otherwise known as Special Protection Systems (SPS), are becoming more common among utilities. This presentation will provide an overview of why these schemes are necessary, cover different types of RAS schemes, and discuss design criteria to help understand these sometimes complicated systems.

Transformer Protection

Scott Cooper, Manta Test Systems, St. Petersburg, FL

An overview of power transformer protection practices. Emphasis is placed on solutions to the challenges of effective protection including transformation ratio, transformer connection, current transformer connections, zero sequence current elimination, inrush, and over excitation. Analysis of differential relay operation for various types of faults and fault locations is discussed.

FRIDAY FEATURE PRESENTATIONS

San Diego Disturbance

Rich Bauer, Idaho Power Company, Boise, ID

The September 8, 2011 Southwest Blackout resulted in over 2.5 million customers without power. A single switching error initiated this cascading event. This lecture will cover the chronology of that event and discuss the lessons learned from this widespread outage.

Integration of Wind Resources
into the BPA Grid*Eric King, Bonneville Power Administration, Portland, OR*

Wind Power is projected to double over the next few years in the Pacific Northwest if all the planned projects are built. This is a discussion of the technical problems that BPA and Project Owners have to solve for both present and planned alternative energy generators.



2013 SCHEDULE

The Hands-On Relay School is held on the Washington State University campus in Pullman, Washington. Evening events and Sunday check-in registration are held at the University Inn Best Western in Moscow, ID, or as noted.

Sunday, March 10

3:00-6:00 PM	Facilitator Lab Set Up (EE/ME 44)
5:30-7:30 PM	Registration & Reception (University Inn)
7:30-8:30 PM	Lab Facilitator Meeting (University Inn)

Monday, March 11

6:45-7:30 AM	Registration
7:30 AM-Noon	Opening Announcements Overview Lectures Concurrent Open Lectures Introduction to System Protection Lecture Series
1:00-5:00 PM	Hands-on Lab Instruction
5:00 PM	Optional Social Event (Zeppos)

Tuesday, March 12

7:30 AM-Noon	Concurrent Open Lectures
1:00-5:00 PM	Hands-on Lab Instruction
6:30-9:00 PM	Suppliers Showcase (University Inn)

Wednesday, March 13

7:30 AM-Noon	Hands-on Lab Instruction
1:00-5:00 PM	Hands-on Lab Instruction
6:30-9:00 PM	Banquet & Entertainment (University Inn)

Thursday, March 14

7:30 AM-Noon	Hands-on Lab Instruction
1:00-5:00 PM	Hands-on Lab Instruction

Friday, March 15

7:30-8:00 AM	Open Panel Discussion
8:00-11:30 AM	Friday Feature Presentations

RELAY SCHOOL

SPONSORS



CONFERENCE MANAGEMENT


WesternEnergy
INSTITUTE

STEERING COMMITTEE

Cliff Harris	<i>Committee Chair, Idaho Power Company</i>
Rodger Allen	<i>U.S. Bureau of Reclamation</i>
Rick Asche	<i>Portland General Electric</i>
Bob Byrne	<i>NV Energy</i>
James Cornett	<i>Salt River Project</i>
Kurt Dobin	<i>PacificCorp</i>
Chris Gallacher	<i>Bonneville Power Administration</i>
Tamara Kirk	<i>Washington State University</i>
Sonny Langhurst	<i>US Bureau of Reclamation</i>
Jeff Marsh	<i>Avista Utilities</i>
Pat Modrell	<i>Seattle City Light</i>
Kelly Newell	<i>Washington State University</i>
Darcy Nutter	<i>Western Energy Institute</i>
Mike O'Neal	<i>NV Energy, Retired</i>
Gilbert Salcido	<i>Salt River Project, Retired</i>
Randy Turnley	<i>Puget Sound Energy</i>
Bill Unbehaun	<i>Tacoma Power</i>
Darryl Walker	<i>Puget Sound Energy</i>
Louis Wright	<i>Bonneville Power Administration</i>
John Yates	<i>Washington State University</i>

CONTRIBUTING ORGANIZATIONS

The Hands-On Relay School Steering Committee gratefully acknowledges the following organizations for their generous contributions of equipment and support personnel.

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|-----------------------------------|---------------------------------------|
| ABB Power T&D Company Inc. | Pacific Gas & Electric |
| ATG Consulting | Peak Measure |
| Avista Utilities | Pegasus–Global |
| Basler Electric Company | Portland General Electric |
| Beckwith Electric Company | Power Testing and Energization Inc. |
| Benton County PUD | PPL Montana |
| Bonneville Power Administration | Puget Sound Energy |
| BSC Engineered Systems | Quanta Technology |
| Central Electric Cooperative Inc. | Relay Application Innovation |
| Central Lincoln PUD | RFL Electronics Inc. |
| Chelan County PUD | RuggedCom |
| Clark Public Utilities | Sacramento Municipal Utility District |
| Cooper Power Systems | Salt River Project |
| Doble Engineering Company | San Diego Gas & Electric |
| Douglas County PUD | Schneider Electric / M:Com |
| Emerson | Schweitzer Engineering Laboratories |
| Energy Northwest | Seattle City Light |
| ENOSERV | Siemens |
| Eugene Water & Electric | SMC Inc. |
| Franklin County PUD | Snohomish County PUD |
| GE Digital Energy – Multilin | Tacoma Power |
| Grant County PUD | Tri-State G&T |
| Idaho Power Company | Trivetti and Associates |
| Manta Test Systems | U.S. Army Corps of Engineers |
| Matanuska Electric Association | U.S. Bureau of Reclamation |
| Megger | Washington State University |
| NorthWestern Energy | Western Area Power Administration |
| NV Energy | Western Energy Institute |
| OMICRON | |
| PacifiCorp | |

SCHOOL INFORMATION

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Application Process and Fees

- Application is online at <http://cm.wsu.edu/hrs>.
- School fee of \$625 includes electronic copies of lecture notes, Sunday night reception, Tuesday night Vendor Showcase, Wednesday night banquet meal, break refreshments, and parking fees.
- Priority is given to utilities providing lab facilitators, lecturers, steering committee support, and Western Energy Institute member utilities, if the application is received by January 25, 2013. Remaining slots will be filled on a first-come, first-served basis.
- Applicants select which track they wish to attend in order of preference. Every effort will be made to place students into their preferred track, but track placement is by availability and subject to the priorities as described above. Many tracks will fill up and students may not be able to get their preferred track. If we are unable to place you in a track you have selected, or in an acceptable substitute track, your full application fee will be refunded.
- Students will be notified in writing no later than February 8, 2013, of their acceptance into the school and track placement. You are not accepted to attend unless you receive the confirmation of acceptance from WSU.
- Questions? Call **800-942-4978** or **509-335-3530**, or email us at tlkirk@wsu.edu. Visit our website at conferences.wsu.edu.

SCHOOL INFORMATION

Accommodations and Travel

Please make your own travel and hotel reservations once you have received registration confirmation. The Pullman/Moscow Airport is served by Alaska/Horizon Airlines. Spokane International Airport is 80 miles north of Pullman. Link Transportation System Inc. serves Spokane to Pullman (208-882-1223). The Quality Inn (509-332-0500) and Holiday Inn Express (509-334-4437) in Pullman, and the University Inn (208-882-0550) in Moscow, Idaho, have rooms blocked for this event and all will provide local transportation upon request.

Cancellation Policy

Your complete application fee will be refunded if WSU receives your written cancellation notice by **February 25, 2013**. Cancellations made after February 25 are subject to a processing fee of \$310. Students who do not attend and have not cancelled by March 8 are responsible for the full application fee. Substitutions may be made at any time.

Program Changes and Cancellations

WSU reserves the right to make changes in programs or speakers or to cancel programs if enrollment criteria are not met. In the unlikely event that this school is cancelled, Washington State University's liability is limited to refund of registration fees. If we are unable to place you in a track you have selected or an acceptable substitute track, your full registration will be refunded.

SCHOOL INFORMATION

Americans with Disabilities Act

Accommodations for individuals who qualify under the Americans with Disabilities Act are available upon request. Please contact us at least ten days before the school at **800-942-4978** or **509-335-3530**, fax **509-335-7781**.

Continuing Education Units (CEUs)

CEUs are available to participants who complete a CEU enrollment form prior to the start of the school and satisfactorily complete the requirements for the class. CEUs are nationally recognized units of achievement that may be used as evidence of professional development and for job advancement. One CEU is awarded for every 10 hours of instruction, totaling 3.6 for this school. A fee of \$10 must accompany the registration fee to receive the CEU credits.

Promotional Video

Need help convincing your organization about the benefits of attending the Hands-On Relay School? Contact us today to request your copy of our promotional video that demonstrates the invaluable training experience of attending this school or view the video at **www.youtube.com/watch?v=Tu5GmeJg7r0**.

Call **800-942-4978** or **509-335-3530**, or email us at **wsuconf@wsu.edu** for more information.

HANDS-ON Relay School

MARCH 11-15, 2013



BY MAIL:

Washington State University
Conference Management
PO Box 645222
Pullman, WA 99164-5222

BY FAX: 509-335-7781

ONLINE: cm.wsu.edu/hrs

Please print or type. For additional applicants, please duplicate this form. To significantly increase your chances of being accepted, send a facilitator.

Name: _____

Organization: _____

Title: _____

Address: _____

City: _____

State/Province: _____

Zip/Postal Code: _____

Country: _____

Phone: _____

Fax: _____

Attendee email (required): _____

TRACK SELECTION

NUMBER only the tracks you will accept in order of preference (1 being your first choice). Confirmation of your application and track assignment will be e-mailed on February 8, 2013. Students will not be allowed to switch tracks once the school has begun.

Manual Relay Testing

- Basic
 Distribution M/P
 Transmission
 Generation
 Electromechanical
 Theory

Automated Relay Testing

- Doble (Beginning ProTest)
 Doble (Advanced ProTest)
 Enoserv RTS (Beginning)
 Enoserv RTS (Advanced)
 Manta
 Megger AVTS
 Omicron

SCHOOL FEE

- \$625 Please register me for the school (Checks payable to Washington State University, payment in U.S. funds drawn on a U.S. bank.)
 \$10 I would like Continuing Education Units (CEUs).

PAYMENT METHOD

- Check enclosed
 VISA or MasterCard no. _____
 Exp. Date _____ CVV# _____
 Bill my company, purchase order no. _____
 Bill to email _____





CONFERENCE MANAGEMENT

PO Box 645222
Pullman, WA 99164-5222

Non-profit Org.
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