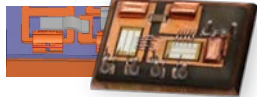




VirginiaTech  
College of  
Engineering

HDI



CPES-Consortium



# CPES

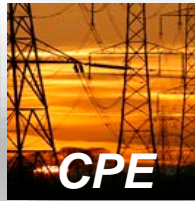
Center for Power Electronics Systems  
The Bradley Department of Electrical and Computer Engineering  
College of Engineering  
Virginia Tech  
Blacksburg, Virginia, USA



WBG  
HPCS



CPES-Consortium

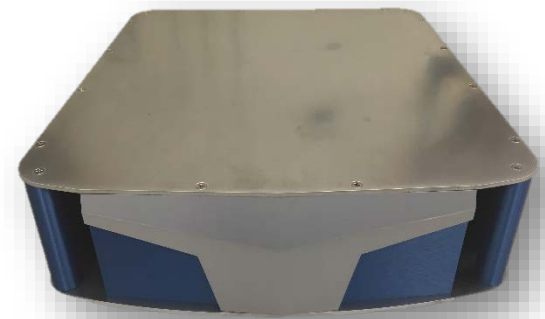


## Graduate Study and Research Program Focused on the Experimentation, Design, Development, and Manufacturing of WBG-Based Power Electronics, Grid Equipment, and High- Efficiency Electrical Systems

*Developing the Future Wide Bandgap Power Electronics Engineering Workforce*



*Presented by:*  
**Jaime de la Ree**



Arlington, VA — June 13-14, 2017

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# WBGen Traineeship Objectives

1. To train the next generation of U.S. citizen power engineers with WBG power semiconductor expertise
2. To broaden the range of WBG-based power electronics by conducting research on high-efficiency grid apparatus and power systems
3. To enhance the power engineering curriculum by formalizing WBG-oriented design procedures for power electronics components and systems



# WBGen Four-Pillar Strategy

1. Recruiting and Retention (R&R)
2. Partnership
3. Research
4. Curriculum

## ***Execution:***

- Recruit 5 fellows per academic year (2016–2020)
  - Support MS for 2 years, PhD for 4 years
- Active, continuous recruiting and networking to attract top candidates from U.S. universities
- Immediate involvement of fellows in hands-on research on WBG-based power engineering
- Direct collaboration with industry and active networking

This presentation does not contain any proprietary, confidential, or otherwise restricted information.

# WBGen Fellows—First Generation



Amy Romero  
BS, Virginia Tech  
Jan. 2016, MS Program



Paul Rankin  
BS, UNC Charlotte  
Aug. 2016, MS Program



Victor Turriate  
Boeing (BS, Virginia Tech)  
Aug. 2016, MS Program



Joseph Kozak  
BS, MS  
University of Pittsburgh  
Aug. 2016, PhD Program



Rebecca Rye  
BS, Virginia Tech  
May 2017, MS Program  
(Joined as UG/G in Aug. 2016)

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# WBGen Fellows Starting in August 2017

## **Patrick Gu**

BS, University of Illinois, Urbana  
MS, Southern Illinois University  
*PhD Program*

## **Joshua Stewart**

BS, MS  
University of New Mexico, Albuquerque  
*PhD Program*

## **David Nam**

BS, University of South Carolina  
*Direct PhD*

## **Lee Gill**

BS, University of Illinois, Urbana  
*Direct PhD*

## **Emma Raszmann**

BS, University of Pittsburgh  
*Direct PhD Program*

## **Grace Watt**

BS, Davidson College  
*MS Program*

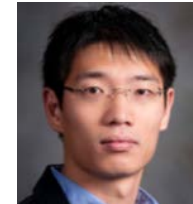
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# WBGen Faculty

## Center for Power Electronics Systems

- Fred C. Lee
- Dushan Boroyevich
- Khai D. T. Ngo
- Rolando Burgos, WBGen PI
- Qiang Li
- G.Q. Lu



## Center for Power and Energy

- Lamine Mili
- Jaime de la Ree
- Virgilio Centeno
- Vassilis Kekatos



## College of Engineering (CoE)

- Catherine Amelink



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# WBGen Recruiting & Retention

- Integrated into **CoE's New Horizon** program devoted to attracting underrepresented groups and minorities
  - WBGen is a new destination for New Horizon scholars
  - Features: summer-bridge transition, peer-mentoring, and professional networking
- Integrated into **ECE** recruiting programs and **Bradley and Webber** fellowships for U.S. citizens and women
- Direct contact with power engineering faculty at U.S. universities



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# WBGen Partnership Program



United States  
Naval Research Laboratory



Dominion



GE  
Aviation



- Internships Summer 2017
  - NREL, ABB, GM, Dominion, VPT

## ***Additional collaboration at CPES:***

- CPES' 80 industry members
- HDI and WBG-HPCS industrial consortia
  - High-Density Integration
  - WBG High Power Converters and Systems
- PowerAmerica program at CPES

HDI



CPES-Consortium

WBG  
HPCS



CPES-Consortium



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# Ongoing Research

- Amy Romero

- Characterization of WBG semiconductors and design of SiC power modules (*Partners*: HRL, GM, ARPA-E, DoE)

- Paul Rankin

- Design, construction and testing of three-level dc-dc converter for commercial SiC UPS (*Partners*: PowerAmerica, ABB)

- Victor Turriate

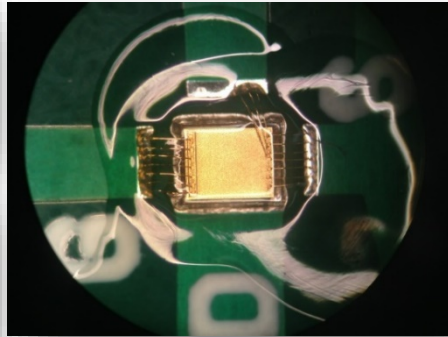
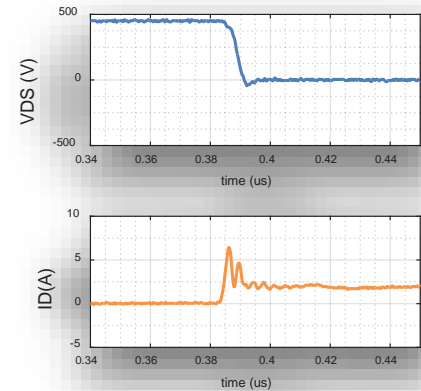
- Construction and testing of three-level inverters for motor drives in aerospace applications (*Partner*: UTAS)

- Joseph Kozak

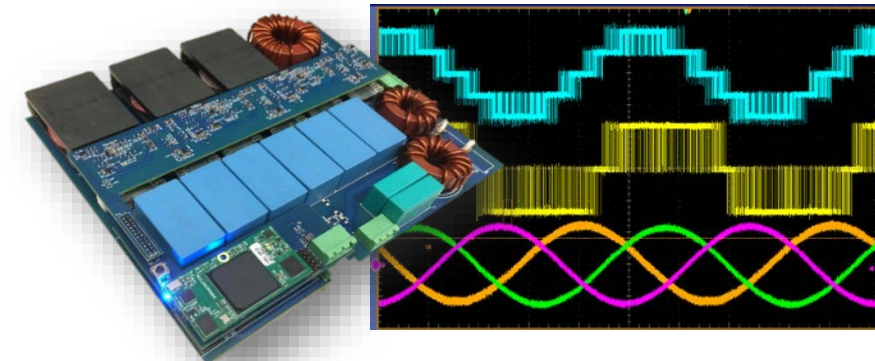
- Investigation of parametric degradation of SiC MOSFET devices under accelerated ageing testing (*Partner*: NREL)



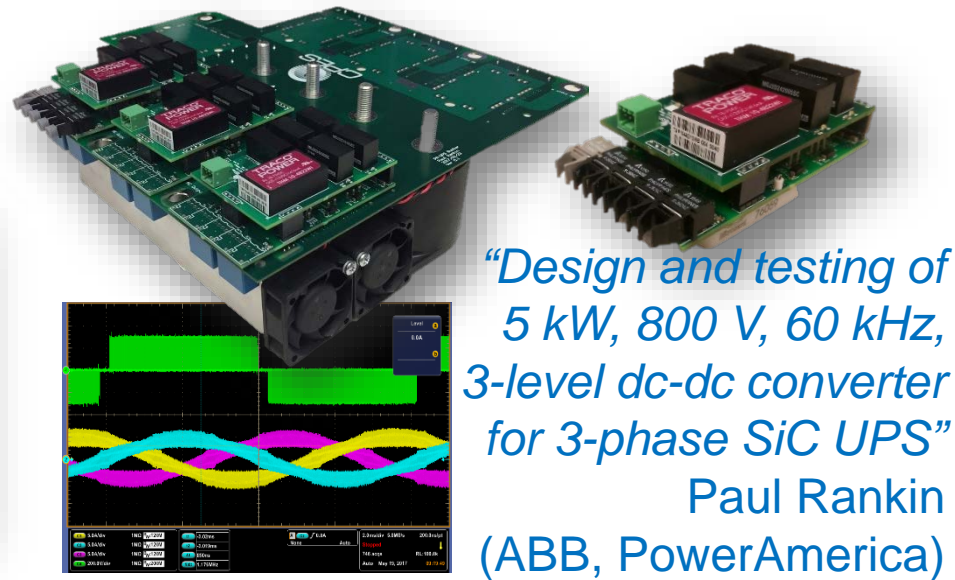
# Research Highlights



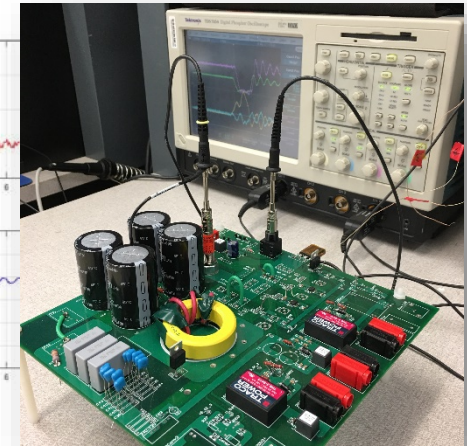
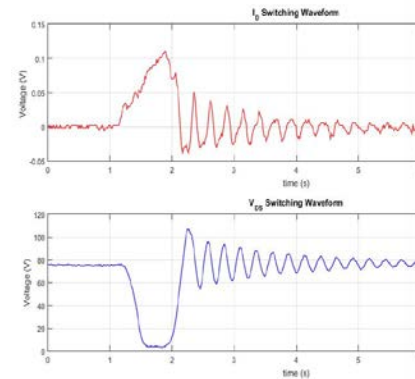
*“Dynamic characterization of 1<sup>st</sup> 600 V, 2 A vertical GaN-on-GaN e-mode transistor”*  
Amy Romero (HRL, ARPA-E SWITCHES)



*“Construction and testing of extreme efficiency (99.2 %) modular 3-level inverter”*  
Victor Turriate (UT Aerospace Systems)



*“Design and testing of 5 kW, 800 V, 60 kHz, 3-level dc-dc converter for 3-phase SiC UPS”*  
Paul Rankin (ABB, PowerAmerica)



*“Accelerated ageing and parametric degradation testing of SiC MOSFETs”*  
Joseph Kozak (NREL)

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# Curriculum Development

- The Bradley Department of Electrical and Computer Engineering (ECE) approved the creation of 13 new majors, including:
  - Major on Energy and Power Electronics Systems (EPES)
- *WBGen* faculty are developing new curriculum
  - ECE 3304 Intro to Power Systems
  - ECE 3354 Power System and Power Electronics Lab
  - ECE 3324 Intro to Power Electronics
  - ECE 4224 Power Electronics
  - ECE 4384 Power Systems Lab (Elective)
  - ECE 4284 Power Electronics Lab (Elective)



# WBGen Expected Outcome

- Train 20–30 graduate students
  - Award >10 MS degrees
  - Award 3–6 PhD degrees
- Provide a strong, hands-on training and education in WBG-based power engineering
  - Power electronics + power systems
- Form the next generation of power engineering faculty and government scientists
- Strengthen the future domestic WBG-based power engineering industry

