Co-sponsors of Virginia Proposal T2701.1.1-18
James Erler, John Lane, Neil Harrington
Contact: James Erler
Jim@ErlerDesign.com
434-953-6747

PUBLIC COMMENTS
JUNE 26, 2020
VIRGINIA SET TO APPROVE ELECTRIC CODE THAT CAUSES ELECTRIC SHOCK DROWNING

The Virginia 2018 Code Development Cycle is nearing completion. Changes in the code will go into effect in 2021. The Virginia DHCD Residential Dock Electrical Safety Subworkgroup (RDESS) refuses to address the electric shock hazards at residential docks and mandates signs on docks that state: WARNING – POTENTIAL SHOCK HAZARD – ELECTRICAL CURRENTS MAY BE PRESENT IN THE WATER. Their message: NO SWIMMING AT RESIDENTIAL DOCKS.

Significantly, the International Electric Code (IEC) addresses ALL outdoor power wiring/grounding because ALL of them represent a danger allowed by the present grounding methods. Pools, fountains, irrigation systems, grounded power equipment etc. are the reason why countries that DON'T have powered docks adopted the TT system. See #4 below.

How and why has this happening?

1. Revised code replaces personal-protection ground fault interrupt breakers (GFCIs) with equipment-protection ground fault interrupt breakers (GFPEs), making docks much more dangerous.
    a. The present code (2014 National Electric Code - NEC) requires personal protection GFCIs (that trip at 4 to 6 mA) at residential docks since residential docks are treated the same as out-buildings.
    b. The new code (2017 NEC) treats residential docks the same as marinas. When the 2017 NEC was first released it required personal protection GFCIs, but this was later modified to equipment protection GFPEs (that trip at 30 mA) in response to complaints of nuisance tripping from marina operators. Electrical requirements at marinas are more complex and include dock-side power for boats that often leak electricity into the water, causing nuisance tripping of personal protection GFCIs.
    c. The threshold current for electric shock drowning (ESD) is 10 mA. The change from 4-6 mA GFCIs to 30 mA GFPEs removes personal protection provided in the present (2014 NEC) code. Marina waters are posted for no swimming because of multiple power sources.
2. The Virginia RDESS is ruled by National Fire Protection Association (NFPA) members. No changes are made unless NFPA members approve.
    a. Code making panels at the NFPA, who create the National Electric Code (NEC), are controlled by industry. Industry representatives who are also members of NFPA are a powerful lobbying coalition that fight modifications to the NEC in all 50 states, including Virginia.
3. NFPA refuses to adopt a cure for dock related shock death hazards.

    a. Over the years a number of proposals have been made to NFPA code making panels to address electric shock hazards at residential docks and swimming pools. These have been refused without explanation or for cost reasons.
4. NFPA and the RDESS refuse to consider a safer grounding system that was adopted 20 years ago by the International Electric Code and is in use throughout the rest of the world.
    a. In addition to the personal vs. equipment protection ground fault protection issue (See item 1), the grounding system required by the NEC is known to allow unwanted voltage spikes into the system, causing ESD.
    b. A solution that addresses the ESD risks in the present grounding system and follows the International Electric Code was proposed to the RDESS in the 2018 Code Development Cycle. The United States is the only developed country that does not include this solution. NFPA members have insisted, without proof, that the IEC solution could not be applied in the USA.
5. NFPA members and the RDESS managers refuse to conduct science or offer evidentiary proof why no ESD solution is provided to the public.
    a. Industry leaders that control the code making process are experts in understanding the very complex national electric code (NEC). While they bring valuable practical experience, they lack adequate understanding of the underlying science of electricity. Instead, they retreat into NEC regulatory scriptures as the source of scientific fact. Any attempt to change NEC/NFPA minds on the ESD issue meets opposition from their ranks.
    b. The IEC approach presented by the sponsors of this proposal is well supported by data and measurements, which was presented to the RDESS in the 2018 Code Development Cycle. NFPA members at the meeting universally objected but presented no counter evidence or research and made false statements [Examples: natural electrical currents in the lake, GFCI will not work without the green grounding wire, etc.]. Virginia RDESS managers lack the technical skills to differentiate between truth and fiction and lean heavily on NFPA members for advice.
6. Leading national scientists have signed a statement of support refuting the false statements made by NFPA members and supporting the proposed changes to address ESD. See attached.
7. NFPA and RDESS require warning signs at residential docks, declaring that swimming is dangerous. They offer no solution to eliminating ESD risk at swim docks, but try to cover their failure with warnings.
    a. NFPA and RDESS either [i] refuse to acknowledge that thousands of residential docks are built for and will continue to be used as swimming platforms, or [ii] admit swimming is expected at residential docks but require warning signs stating that electricity may be in the water.
    b. Being unwilling to remove the risks of electric shock at residential docks, the NFPA and the RDESS choose to require warning signs to absolve them of liability.

Conclusions:

1. The ESD risk can be solved by adoption of the IEC grounding approach.

2. NFPA, and the supplicant Virginia RDSS, refuse to adopt the IEC approach.

3. Swimmers remain at risk of death or disability due to NFPA's refusal to change its NEC code.

Co-sponsors of Virginia Proposal T2701.1.1-18
James Erler, John Lane, Neil Harrington
Contact: James Erler
Jim@ErlerDesign.com
434-953-6747

PUBLIC COMMENTS
JUNE 26, 2020
VIRGINIA SET TO APPROVE ELECTRIC CODE THAT CAUSES ELECTRIC SHOCK DROWNING

The Virginia 2018 Code Development Cycle is nearing completion. Changes in the code will go into effect in 2021. The Virginia DHCD Residential Dock Electrical Safety Subworkgroup (RDESS) refuses to address the electric shock hazards at residential docks and mandates signs on docks that state: WARNING – POTENTIAL SHOCK HAZARD – ELECTRICAL CURRENTS MAY BE PRESENT IN THE WATER. Their message: NO SWIMMING AT RESIDENTIAL DOCKS.

Significantly, the International Electric Code (IEC) addresses ALL outdoor power wiring/grounding because ALL of them represent a danger allowed by the present grounding methods. Pools, fountains, irrigation systems, grounded power equipment etc. are the reason why countries that DON'T have powered docks adopted the TT system. See #4 below.

How and why has this happening?

1. Revised code replaces personal-protection ground fault interrupt breakers (GFCIs) with equipment-protection ground fault interrupt breakers (GFPEs), making docks much more dangerous.
    a. The present code (2014 National Electric Code - NEC) requires personal protection GFCIs (that trip at 4 to 6 mA) at residential docks since residential docks are treated the same as out-buildings.
    b. The new code (2017 NEC) treats residential docks the same as marinas. When the 2017 NEC was first released it required personal protection GFCIs, but this was later modified to equipment protection GFPEs (that trip at 30 mA) in response to complaints of nuisance tripping from marina operators. Electrical requirements at marinas are more complex and include dock-side power for boats that often leak electricity into the water, causing nuisance tripping of personal protection GFCIs.
    c. The threshold current for electric shock drowning (ESD) is 10 mA. The change from 4-6 mA GFCIs to 30 mA GFPEs removes personal protection provided in the present (2014 NEC) code. Marina waters are posted for no swimming because of multiple power sources.
2. The Virginia RDESS is ruled by National Fire Protection Association (NFPA) members. No changes are made unless NFPA members approve.
    a. Code making panels at the NFPA, who create the National Electric Code (NEC), are controlled by industry. Industry representatives who are also members of NFPA are a powerful lobbying coalition that fight modifications to the NEC in all 50 states, including Virginia.
3. NFPA refuses to adopt a cure for dock related shock death hazards.

    a. Over the years a number of proposals have been made to NFPA code making panels to address electric shock hazards at residential docks and swimming pools. These have been refused without explanation or for cost reasons.
4. NFPA and the RDESS refuse to consider a safer grounding system that was adopted 20 years ago by the International Electric Code and is in use throughout the rest of the world.
    a. In addition to the personal vs. equipment protection ground fault protection issue (See item 1), the grounding system required by the NEC is known to allow unwanted voltage spikes into the system, causing ESD.
    b. A solution that addresses the ESD risks in the present grounding system and follows the International Electric Code was proposed to the RDESS in the 2018 Code Development Cycle. The United States is the only developed country that does not include this solution. NFPA members have insisted, without proof, that the IEC solution could not be applied in the USA.
5. NFPA members and the RDESS managers refuse to conduct science or offer evidentiary proof why no ESD solution is provided to the public.
    a. Industry leaders that control the code making process are experts in understanding the very complex national electric code (NEC). While they bring valuable practical experience, they lack adequate understanding of the underlying science of electricity. Instead, they retreat into NEC regulatory scriptures as the source of scientific fact. Any attempt to change NEC/NFPA minds on the ESD issue meets opposition from their ranks.
    b. The IEC approach presented by the sponsors of this proposal is well supported by data and measurements, which was presented to the RDESS in the 2018 Code Development Cycle. NFPA members at the meeting universally objected but presented no counter evidence or research and made false statements [Examples: natural electrical currents in the lake, GFCI will not work without the green grounding wire, etc.]. Virginia RDESS managers lack the technical skills to differentiate between truth and fiction and lean heavily on NFPA members for advice.
6. Leading national scientists have signed a statement of support refuting the false statements made by NFPA members and supporting the proposed changes to address ESD. See attached.
7. NFPA and RDESS require warning signs at residential docks, declaring that swimming is dangerous. They offer no solution to eliminating ESD risk at swim docks, but try to cover their failure with warnings.
    a. NFPA and RDESS either [i] refuse to acknowledge that thousands of residential docks are built for and will continue to be used as swimming platforms, or [ii] admit swimming is expected at residential docks but require warning signs stating that electricity may be in the water.
    b. Being unwilling to remove the risks of electric shock at residential docks, the NFPA and the RDESS choose to require warning signs to absolve them of liability.

Conclusions:

1. The ESD risk can be solved by adoption of the IEC grounding approach.

2. NFPA, and the supplicant Virginia RDSS, refuse to adopt the IEC approach.

3. Swimmers remain at risk of death or disability due to NFPA's refusal to change its NEC code.

Statement of Support

By Douglas Dorr

Subject: Proposed change in the National Electric Code (NEC)/NFPA 70 (Virginia Proposal T2701.1.1-18) to address risk of Electric Shock Drowning (ESD) at residential docks in Virginia.

I have reviewed the data, research and analysis developed by Mr. James Erler regarding ESD at residential docks. (http://erlerdesign.com/download/ESD_Review/) As an experienced expert in the design and analysis of electrical circuits and the underlying science surrounding electricity, and with particular experience in electrical grounding, I understand the materials that Mr. Erler has provided to me.

I agree with the following conclusions:

1. The wiring requirements in section 555 of the 2017 NEC for residential docks form circuits that place intermittent voltages and currents on grounded dock structures that are sufficient to cause ESD injury or death.
2. Voltages and currents are delivered to grounded dock structures via the "green" ground conductor between the dock and house service panels.
3. Removing, disconnecting or isolating the "green" ground conductor between the house and dock service panels removes the risk of ESD due to elevated ground voltages. There must be a separate earthed ground electrode at the dock that is connected to equipment ground. Equipment ground must NOT be connected to the neutral conductor from the electrical supply. In addition, all circuit breakers at the dock service panel must be 4 to 6 mA, personal protection, GFCIs.
4. Claims by members of the National Fire Protection Association (NFPA) that the source of stray voltages/currents is some sort of current naturally flowing in the earth are false and not supported by scientific fact.
5. Grounded electrodes required in Section 555 of the NEC for installation at the house and dock do not reduce the current into the water and the associated shock hazard. The resistance of these connections to earth are too large to reduce the voltages on grounded structures to safe levels.
6. Claims by NFPA members that the "green" ground conductor is required for GFCIs to operate are false.
7. Claims by NFPA members that GFCIs will not trip if there is a fault to a grounded structure connected to an earthed electrode are false.
8. Statements in the NEC that the earth can never be used as a return conductor are correct when applied to neutral returns, but are incorrect when applied to ground fault interrupt devices such as GFCIs.

9. Between the 2014 NEC and the 2017 NEC, the requirement for 4 to 6 mA personal protection GFCI breakers was replaced with 30 mA equipment protection GFPE breakers. As ESD is caused by currents above 10 mA, this is a very dangerous change. All breakers at residential docks must be 4 to 6 mA personal protection GFCI breakers.

Name: Douglas Dorr Date: 04/21/2020

Signature: 

Qualifications (please attach a resume/publications list or provide degrees and/or experience below):
Douglas Dorr is a Technical Executive with the Electric Power Research Institute. For the past 25 years Mr. Dorr has been involved in Electric Power System research and development with a special focus on stray and contact voltage shock and perception investigations. Mr. Dorr has participated in over fifty electric shock investigations at swimming pools, boat docks, marinas, confined livestock areas and power distribution system contact points. He has authored well over a dozen peer reviewed papers and guidebooks on stray voltage, contact voltage, equipotential bonding and wiring and grounding topics. He has also developed specialized test and measurement equipment and procedures to support field investigators. As a Senior Member of the IEEE, Mr. Dorr chaired the most recent revision to the IEEE Emerald Book – Recommended Practice for Powering and Grounding Electronic Equipment and he is the long time Chair for the IEEE SPDC 3.6.4 Working Group on Characterization of the Lightning and Surge Environment. Mr. Dorr received a Bachelor's degree in Engineering from Indiana Institute of Technology in 1989.

Additional Comments:

Relative to item 3 (removing, disconnecting, or isolating the green wire between the dock sub panel and the main service - this precedent is already established by NEC article 406 (for ungrounded branch circuits). The proposal extends the concept to a sub panel application. In any case, regardless of the means (i.e. removal, isolation or disconnecting) proper labeling and properly rated GFCI protection would be required. It should additionally be noted that for the proposed implementation GFCI protection is required at both the main service panel and at each breaker for the dock equipment.

Statement of Support

By FRANK C. LAMBERT, P.E.

Subject: Proposed change in the National Electric Code (NEC)/NFPA 70 (Virginia Proposal T2701.1.1-18) to address risk of Electric Shock Drowning (ESD) at residential docks in Virginia.

I have reviewed the data, research and analysis developed by Mr. James Erler regarding ESD at residential docks. (http://erlerdesign.com/download/ESD_Review/) As an experienced expert in the design and analysis of electrical circuits and the underlying science surrounding electricity, and with particular experience in electrical grounding, I understand the materials that Mr. Erler has provided to me.

I agree with the following conclusions:

1. The grounding requirements in the 2017 NEC for residential docks form circuits that place intermittent voltages and currents on grounded dock structures that are sufficient to cause ESD injury or death.
2. Voltages and currents are delivered to grounded dock structures via the "green" ground conductor between the dock and house service panels.
    a. Claims by members of the National Fire Protection Association (NFPA) that the source of stray voltages/currents is some sort of current naturally flowing in the earth are false and not supported by scientific fact.
3. Grounded electrodes required in the NEC for installation at the house and dock are imperfect, resistive connections to the earth. The resistance of these connections to earth are too large to reduce the voltages on grounded structures to safe levels.
4. Removing the "green" ground conductor between the house and dock service panels removes the risk of ESD due to elevated ground voltages. There must be a separate earthed ground electrode at the dock that is connected to equipment ground. Equipment ground must NOT be connected to the neutral conductor from the electrical supply. In addition, all circuit breakers at the dock service panel must be 4 to 6 mA, personal protection, GFCIs.
    a. Claims by NFPA members that the "green" ground conductor is required for GFCIs to operate are false.
    b. Claims by NFPA members that GFCIs will not trip if there is a fault to a grounded structure connected to an earthed electrode are false.
    c. Statements in the NEC that the earth can never be used as a return conductor are correct when applied to neutral returns, but are incorrect when applied to ground fault interrupt devices such as GFCIs.
5. Between the 2014 NEC and the 2017 NEC, the requirement for 4 to 6 mA personal protection GFCI breakers was replaced with 30 mA equipment protection GFPE breakers. As ESD is caused by currents above 10 mA, this is a very dangerous change. All breakers at residential docks must be 4 to 6 mA personal protection GFCI breakers.

Name: Frank C. Lambert Date: April 21, 2020

Signature: Frank C. Lambert

Qualifications (please attach a resume/publications list or provide degrees and/or experience below):

See Attached.

Additional Comments:

Franklin Cook Lambert, P.E.
Principal Research Engineer
National Electric Energy Testing, Research, and Applications Center
Center for Distributed Energy
School of Electrical and Computer Engineering
Georgia Institute of Technology

EDUCATIONAL BACKGROUND:

Degree	Year	University	Field
M.S.E.E.	1976	Georgia Institute of Technology	Power Systems
B.E.E.	1973	Georgia Institute of Technology	Power Systems

EMPLOYMENT HISTORY:

Title	Organization	Years
Principal Research Engineer	NEETRAC / Georgia Tech	14
Sr. Research Engineer	NEETRAC / Georgia Tech	11
Distribution Manager	Georgia Power Company	5
Manager, Network Underground	Georgia Power Company	2
Research Manager	Georgia Power Company	8
Network Test Supervisor	Georgia Power Company	2
Research Engineer	Georgia Power Company	1
Transmission Engineer	Georgia Power Company	1
Distribution Engineer	Georgia Power Company	3

CURRENT FIELDS OF INTEREST:

Power Delivery Equipment, Automation and Systems; Fault Current Limiters, Power Quality; Communications for Electric Utility Automation (WiMAX, Wireless Sensor Networks, Wireless Mesh Networks), Grid Connected Hybrid Vehicles,

QUALIFICATION STATEMENT:

Mr. Lambert is nationally recognized as an industry expert in electrical distribution and transmission systems. His 22 years of broad engineering and management experience with the Georgia Power Company have been integrated into a comprehensive research and development program in Electrical Systems at Georgia Tech for NEETRAC. Mr. Lambert serves as the Associate Director and Program Manager for Systems Analysis at NEETRAC. Over the last 23 years, he has directed 138 research projects with a total budget of over $15,000,000 focused on new developments and improvements in the electric power delivery infrastructure including the development of grid connected electric and hybrid vehicles. A number of these research projects have involved faculty

and graduate students from ECE Power and Telecommunications, MSE, ME, Chemistry, ISyE, and GTRI. His experience includes the design, construction and operation of the Georgia Power Company / Georgia Tech NEETRAC laboratory facilities.

Mr. Lambert is leading two new ARPA-E initiatives in collaboration with faculty from ECE and ME: development of Smart Wires technology to control power flows on the transmission network and development of a medium voltage test bed for power flow control technologies.

The technical contributions of Mr. Lambert are evidenced through his involvement in both local and national professional industry activities. He led the Atlanta Chapter of IEEE Power Engineering Society and was recognized as Chairman of the Outstanding Chapter in 1994. At the international level, he has served on a wide variety of industry standards committees and presently focuses his activities primarily through working groups of the IEEE PES Distribution Subcommittee addressing exposure voltages, Smart Distribution, reliability and power quality issues and the IEEE PES Switchgear Committee on High Voltage Fuses and Fault Current Limiters. He also served on CIGRE Working Group A3.23 to develop an Application Guide for Fault Current Limiters. Mr. Lambert was elected President Elect of IEEE PES in 2018 and is currently serving as PES President.

Mr. Lambert has also provided leadership to development of standards for electric and hybrid vehicle interconnection to the electric utility grid. He has served as Chair of the Society of Automotive Engineers (SAE) Committee J2293 which developed the charging interface protocols for electric vehicles and now chairs the working group on Plug-in hybrid and electric vehicles for the Infrastructure Working Council.

Mr. Lambert has also been active in service to Georgia Tech and the education community. He has served as Chair of the Welfare and Security Committee of the Faculty and chaired of the ad-hoc committee to develop a comprehensive implementation plan for Automatic External Defibrillators (AEDs) on campus. Mr. Lambert also served for 14 years as a Member of the Fulton County Board of Education.

I. RESEARCH AND CREATIVE SCHOLARSHIP

A. <u>Research Program Development</u>

Mr. Lambert is responsible for the Systems and Analysis Program for NEETRAC. This includes research work on power transmission and distribution equipment, automation, and systems; electrical insulation systems; power electronics; power quality; grounding; information and energy distribution integration; and electric & hybrid vehicles.

Two new major research program initiatives are currently underway:

1. An initial project was launched in 2009 with our NEETRAC members to develop and test Smart Wires technology for control of power flow on the transmission grid. ARPA-E funding was added in 2012 and the pilot implementation installed on a 161 kV transmission line in the TVA grid in October 2012.
2. In collaboration with Dr. Santiago Grijalva in ECE, a project was launched with ARPA-E in 2012 to develop a test bed at NEETRAC to evaluate the performance of new medium voltage power flow control technologies for the grid.

B. <u>Research Proposals and Contracts/Grants (PI)</u>

Mr. Lambert served as the PI for the following projects. As the PI, he was responsible for each project report, which range in length from 20 to over 400 pages. The Intellectual Property of those projects funded through NEETRAC is controlled by the NEETRAC Management Board and outside publication is restricted.

Title: Olympic Electric Tram System
Sponsor: NEETRAC
Co-P.I.(s): Dr. Richard Bass
Amount Requested: $49,900 Date Submitted: 2/27/96
Result: Awarded
Funded: $49,900 Period of Performance: 7 months

Title: PV System Performance
Sponsor: NEETRAC
Co-P.I.(s): Dr. Miroslav Begovic
Amount Requested: $36,200 Date Submitted: 2/27/96
Result: Awarded
Funded: $36,200 Period of Performance: 7 months

Title: Life Cycle Cost Analysis of the Distribution System
Sponsor: NEETRAC
Co-P.I.(s): Dr. Miroslav Begovic
Amount Requested: $48,700 Date Submitted: 2/27/96
Result: Awarded
Funded: $48,700 Period of Performance: 9 months

Title: Electric Vehicle – Hybrid Vehicle Simulation Model
Sponsor: NEETRAC / DARPA
Co-P.I.(s): Dr. Tom Habetler
Amount Requested: $200,000 Date Submitted: 2/27/96
Result: Awarded
Funded: $200,000 Period of Performance: 18 months

Title: Lightning Performance Based Grounding Design & Analysis of the Transmission System
Sponsor: NEETRAC
Co-P.I.(s): Dr. Sakis Meliopoulos, Shashi Patel
Amount Requested: $75,400 Date Submitted: 8/26/96
Result: Awarded
Funded: $75,400 Period of Performance: 18 months

Title: Application of Lightning Arresters on Transmission Lines
Sponsor: NEETRAC
Co-P.I.(s): Dr. Sakis Meliopoulos, Shashi Patel
Amount Requested: $57,800 Date Submitted: 8/26/96
Result: Awarded
Funded: $57,800 Period of Performance: 18 months

Title: Power Quality Impact of EV Charging on the Distribution System
Sponsor: Electric Power Research Institute
Co-P.I.(s): Dr. Richard M. Bass
Amount Requested: $50,000 Date Submitted: 11/6/96
Result: Awarded
Funded: $50,000 Period of Performance: 10 months

Title: Electric Transportation Program Support
Sponsor: Georgia Power Company
Amount Requested: $188,604 Date Submitted: 12/20/96
Result: Awarded
Funded: $188,604 Period of Performance: 12 months

Title: Electric Transit Vehicle Institute - 31 ft. Electric Bus Development
Sponsor: DARPA
Amount Requested: $20,000 Date Submitted: 1/30/97
Result: Awarded
Funded: $20,000 Period of Performance: 3 months

Title: Rapid Charging and Battery Management for Heavy Duty Electric Vehicles
Sponsor: DARPA
Co-P.I.(s): Dr. Caryn Riley
Amount Requested: $331,690 Date Submitted: 2/1/97
Result: Awarded
Funded: $331,690 Period of Performance: 24 months

Title: Transmission Reliability, Unknown or Unexplained Outages
Sponsor: NEETRAC
Amount Requested: $39,400 Date Submitted: 5/21/97
Result: Awarded

Funded: $39,400 Period of Performance: 9 months

Title: EV Data Collection Procedure Development
Sponsor: EPRI
Amount Requested: $9,050 Date Submitted: 5/25/97
Result: Awarded
Funded: $9,050 Period of Performance: 3 months

Title: Bus EV Charging Issues
Sponsor: EPRI
Co-P.I.(s): Dr. Richard Bass
Amount Requested: $16,980 Date Submitted: 7/23/97
Result: Awarded
Funded: $16,980 Period of Performance: 7 months

Title: Distribution System Equipment Reliability Centered Maintenance Program Model
Sponsor: NEETRAC
Co-P.I.(s): Dr. Anton Kleywegt (ISYE)
Amount Requested: $111,058 Date Submitted: 8/28/97
Result: Awarded
Funded: $111,058 Period of Performance: 12 months

Title: Life Cycling of the Distribution System - Phase II
Sponsor: NEETRAC
Co-P.I.(s): Dr. Miroslav Begovic
Amount Requested: $99,153 Date Submitted: 8/28/97
Result: Awarded
Funded: $99,153 Period of Performance: 12 months

Title: Distribution System Grounding & Power Quality Guidelines
Sponsor: NEETRAC
Co-P.I.(s): Dr. Sakis Meliopoulos
Amount Requested: $12,300 Date Submitted: 11/13/97
Result: Awarded
Funded: $12,300 Period of Performance: 6 months

Title: Accelerated Aging of ADSS Fiberoptic Cables
Sponsor: NEETRAC
Amount Requested: $147,793 Date Submitted: 11/13/97
Result: Awarded
Funded: $147,793 Period of Performance: 18 months

Title: Performance Evaluation of Distribution System MOV Lightning Arresters
Sponsor: NEETRAC

Co-P.I.(s): Ray Hill
Amount Requested: $318,150 Date Submitted: 11/13/97
Result: Awarded
Funded: $318,150 Period of Performance: 7 months

Title: Electric Transportation Program Support
Sponsor: Georgia Power Company
Amount Requested: $203,112 Date Submitted: 12/13/97
Result: Awarded
Funded: $203,112 Period of Performance: 12 months

Title: Feasibility Study for a Decision Support System for Distribution Equipment
Sponsor: Florida Power & Light
Co-P.I.(s): Dr. Anton Kleywegt (ISYE)
Amount Requested: $18,000 Date Submitted: 7/1/98
Result: Awarded
Funded: $18,000 Period of Performance: 6 months

Title: Distribution Transformer Loading
Sponsor: NEETRAC
Amount Requested: $67,478 Date Submitted: 8/26/98
Result: Awarded
Funded: $67,478 Period of Performance: 8 months

Title: Secondary Distribution Impacts of Residential EV Charging
Sponsor: Consortium of California Energy Commission, PG&E,
San Diego D&E, Southern California Edison, Virginia Power, Florida Power & Light, and Southern Company
Co-P.I.(s): Dr. Richard Bass
Amount Requested: $195,000 Date Submitted: 9/13/98
Result: Awarded
Funded: $195,000 Period of Performance: 15 months

Title: Study of the Effects of Electric Vehicles **(**EV's**)** On the Distribution System
Sponsor: Florida Power & Light
Co-P.I.(s): Dr. Richard Bass
Amount Requested: $23,000 Date Submitted: 9/15/98
Result: Awarded
Funded: $23,000 Period of Performance: 6 months

Title: Electric Transportation Program Support
Sponsor: Georgia Power Company
Amount Requested: $213,503 Date Submitted: 12/31/98
Result: Awarded

Funded: $100,000 Period of Performance: 12 months

Title: Transmission and Substation Personnel Safety Ground Testing and Evaluation
Sponsor: NEETRAC
Co-P.I.(s): Shashi Patel
Amount Requested: $80,240 Date Submitted: 1/13/99
Result: Awarded
Funded: $80,240 Period of Performance: 12 months

Title: Impact of Residential HVAC Scroll Compressors on the Distribution System
Sponsor: NEETRAC
Co-P.I.(s): Dr. Miroslav Begovic
Amount Requested: $61,400 Date Submitted: 1/13/99
Result: Awarded
Funded: $61,400 Period of Performance: 7 months

Title: Extension of the Hybrid Electric HMMWV Power Train Development Program – Application as a General Purpose Hybrid Truck Chassis and Introduction as a Utility Industry Trouble Truck and Mobile Power System
Sponsor: DARPA
Co-P.I.(s): Dr. Caryn Riley
Amount Requested: $129,553 Date Submitted: 3/1/99
Result: Awarded
Funded: $129,553 Period of Performance: 24 months

Title: Microstructural Changes Due To Cryogenic Treatment of Cu-W Electrical Contact Tips, Phase 1 – Initial Investigation
Sponsor: Alabama Power Company
Co-P.I.(s): Dr. Arun Gokhale (MSE)
Amount Requested: $15,648 Date Submitted: 3/12/99
Result: Awarded
Funded: $15,648 Period of Performance: 3 months

Title: Padmounted Transformer Evaluation
Sponsor: NEETRAC
Co-P.I.(s): Tom Champion
Amount Requested: $122,650 Date Submitted: 5/13/99
Result: Awarded
Funded: $122,650 Period of Performance: 10 months

Title: Interface Dielectric Test Evaluation of Loadbreak Separable Connectors
Sponsor: NEETRAC
Co-P.I.(s): Tom Champion

Amount Requested: $97,600 Date Submitted: 9/13/99
Result: Awarded
Funded: $97,600 Period of Performance: 11 months

Title: Predictive Maintenance Tests for Power Transformer Bushings
Sponsor: NEETRAC
Co-P.I.(s): Larry Coffeen
Amount Requested: $60,000 Date Submitted: 9/13/99
Result: Awarded
Funded: $60,000 Period of Performance: 12 months

Title: Distribution Transformer Loading – Follow-up Projects
Sponsor: Joint Direct Placed
Amount Requested: $37,050 Date Submitted: 1/5/00
Result: Awarded
Funded: $37,050 Period of Performance: 6 months

Title: IWC Bus/Non-Road Committee Representation
Sponsor: Georgia Power Company
Amount Requested: $35,801 Date Submitted: 2/02/00
Result: Awarded
Funded: $35,801 Period of Performance: 11 months

Title: Power Quality Impacts of Airport GSE Charging Systems
Sponsor: EPRI & California Energy Commission
Co-P.I.(s): Dr. Ron Harley
Amount Requested: $188,000 Date Submitted: 2/21/00
Result: Pending
Funded: Period of Performance: 12 months

Title: Stray Voltages – Concerns, Analysis, and Mitigation
Sponsor: NEETRAC
Co-P.I.(s): Shashi Patel
Amount Requested: $72,000 Date Submitted: 4/05/00
Result: Awarded
Funded: $72,000 Period of Performance: 12 months

Title: Impact of Residential HVAC Compressors on the Distribution System
Sponsor: NEETRAC
Co-P.I.(s): Miroslav Begovic
Amount Requested: $65,260 Date Submitted: 7/23/00
Result: Awarded
Funded: $65,260 Period of Performance: 10 months

Title: Field Evaluation of Distribution System MOV Lightning Arresters –Phase 1
Sponsor: NEETRAC
Co-P.I.(s): Tom Champion
Amount Requested: $25,000 Date Submitted: 8/04/00
Result: Awarded
Funded: $25,000 Period of Performance: 6 months

Title: Distribution Transformer Loading – Cooper FR3
Sponsor: Joint Direct Placed
Amount Requested: $8,600 Date Submitted: 11/1/00
Result: Awarded
Funded: $8,600 Period of Performance: 5 months

Title: IWC Bus/Non-Road Committee Representation
Sponsor: Georgia Power Company
Amount Requested: $35,644 Date Submitted: 12/02/00
Result: Awarded
Funded: $35,644 Period of Performance: 12 months

Title: Characterization of Polypropylene
Sponsor: Cooper
Co-P.I.(s): Jon Crate, GTRI
Amount Requested: $15,675 Date Submitted: 12/04/00
Result: Awarded
Funded: $15,675 Period of Performance: 8 months

Title: Interface Dielectric Test Evaluation of Loadbreak Separable Connectors – Phase 2
Sponsor: NEETRAC
Co-P.I.(s): Tom Champion
Amount Requested: $84,000 Date Submitted: 1/23/01
Result: Awarded
Funded: $84,000 Period of Performance: 12 months

Title: Partial Discharge Detection within On-line Power System Equipment
Sponsor: NEETRAC
Co-P.I.(s): Larry Coffeen
Amount Requested: $105,000 Date Submitted: 1/23/01
Result: Awarded
Funded: $105,000 Period of Performance: 18 months

Title: Transmission and Substation Personnel Safety Ground Testing and Evaluation - Phase 2
Sponsor: NEETRAC

Co-P.I.(s): Shashi Patel
Amount Requested: $67,000 Date Submitted: 1/23/01
Result: Awarded
Funded: $67,000 Period of Performance: 12 months

Title: Distribution Feeder Volt / Var Optimization Strategies
Sponsor: NEETRAC
Co-P.I.(s): Dr. Miroslav Begovic
Amount Requested: $94,200 Date Submitted: 1/23/01
Result: Awarded
Funded: $94,200 Period of Performance: 10 months

Title: Distribution Feeder Protection Strategies
Sponsor: NEETRAC
Co-P.I.(s): Miroslav Begovic
Amount Requested: $75,200 Date Submitted: 1/23/01
Result: Awarded
Funded: $75,200 Period of Performance: 10 months

Title: Distribution System Field HIVARC Leakage Current Test Set Development and Field Testing
Sponsor: NEETRAC
Co-P.I.(s): Jeff Hildreth
Amount Requested: $134,850 Date Submitted: 1/23/01
Result: Awarded
Funded: $99,500 Period of Performance: 15 months

Title: Service Entrance Surge Protective Device - “End-of-Life Failure Mode” New Evaluation Methodology
Sponsor: NEETRAC
Co-P.I.(s): Ray Hill
Amount Requested: $69,200 Date Submitted: 1/23/01
Result: Awarded
Funded: $69,200 Period of Performance: 8 months

Title: Grid Connected Fuel Cell System for Distributed Power Generation
Sponsor: Allied Utility Systems
Co-P.I.(s): Drs. Caryn Riley, Thom Orlando (Chem), Sam Shelton (ME)
Amount Requested: $100,000 Date Submitted: 02/15/01
Result: Awarded
Funded: $100,000 Period of Performance: 12 months

Title: Power Quality Impacts of Airport GSE Charging Systems
Sponsor: EPRI & California Energy Commission
Co-P.I.(s): Dr. Ron Harley

Amount Requested: $188,000 Date Submitted: 2/21/01
Result: Awarded
Funded: $165,000 Period of Performance: 14 months

Title: Evaluation of OH & UG Faulted Circuit Indicators
Sponsor: NEETRAC
Co-P.I.(s): Thomas Parker
Amount Requested: $52,000 Date Submitted: 5/9/01
Result: Awarded
Funded: $52,000 Period of Performance: 8 months

Title: Dielectric Performance of Wildlife Guards and Deterrents
Sponsor: NEETRAC
Co-P.I.(s): Tom Champion, Caryn Riley
Amount Requested: $113,000 Date Submitted: 5/9/01
Result: Awarded
Funded: $113,000 Period of Performance: 15 months

Title: Arrester Energy Handling Capability
Sponsor: NEETRAC
Co-P.I.(s): Ray Hill
Amount Requested: $58,500 Date Submitted: 5/9/01
Result: Awarded
Funded: $58,500 Period of Performance: 10 months

Title: Padmounted Transformer Evaluation - Phase 2
Sponsor: NEETRAC
Co-P.I.(s): Tom Champion
Amount Requested: $144,300 Date Submitted: 5/9/01
Result: Awarded
Funded: $144,300 Period of Performance: 12 months

Title: Powerline Carrier Evaluation
Sponsor: Schlumberger
Co-P.I.(s): Eric Barnhart, GTRI
Amount Requested: $50,000 Date Submitted: 8/26/01
Result: Awarded
Funded: $50,000 Period of Performance: 12 months

Title: Field Evaluation of Distribution MOV Arresters - Phase 2
Sponsor: NEETRAC
Co-P.I.(s): Ray Hill
Amount Requested: $222,100 Date Submitted: 9/25/01
Result: Awarded

Funded: $222,100 Period of Performance: 18 months

Title: PWM Tap Changing Voltage Regulator
Sponsor: Southern States, Inc
Co-P.I.(s): Drs. Ron Harley & Tom Habetler
Amount Requested: $12,300 Date Submitted: 9/01/01
Result: Awarded
Funded: $12,300 Period of Performance: 4 months

Title: PWM Tap Changing Voltage Regulator – Phase 2
Sponsor: Southern States, Inc
Co-P.I.(s): Drs. Ron Harley & Tom Habetler
Amount Requested: $264,052 Date Submitted: 11/21/01
Result: Awarded
Funded: $264,052 Period of Performance: 24 months

Title: IWC Bus/Non-Road Committee Representation
Sponsor: Georgia Power Company
Amount Requested: $31,560 Date Submitted: 01/08/02
Result: Awarded
Funded: $31,560 Period of Performance: 12 months

Title: Evaluation of Neutral Isolation Devices
Sponsor: NEETRAC
Co-P.I.(s): Shashi Patel
Amount Requested: $98,400 Date Submitted: 1/15/02
Result: Awarded
Funded: $98,400 Period of Performance: 15 months

Title: Optimization of Reactive Resources
Sponsor: NEETRAC
Co-P.I.(s): Miroslav Begovic
Amount Requested: $143,800 Date Submitted: 1/15/02
Result: Awarded
Funded: $143,800 Period of Performance: 18 months

Title: Secondary Cable Fault Location Techniques
Sponsor: NEETRAC
Co-P.I.(s): Caryn Riley
Amount Requested: $85,000 Date Submitted: 5/08/02
Result: Awarded
Funded: $85,000 Period of Performance: 12 months

Title: BIL Characteristics of OH Distribution Pole Configurations
Sponsor: NEETRAC
Co-P.I.(s): Caryn Riley
Amount Requested: $98,000 Date Submitted: 5/08/02
Result: Awarded
Funded: $98,000 Period of Performance: 15 months

Title: Fault Duty Capability of UD Separable Connectors
Sponsor: NEETRAC
Co-P.I.(s): Tom Champion
Amount Requested: $79,000 Date Submitted: 5/08/02
Result: Awarded
Funded: $79,000 Period of Performance: 15 months

Title: Protection of Instrumentation, Control, and Data Circuits in Substations
Sponsor: NEETRAC
Co-P.I.(s): Shashi Patel
Amount Requested: $85,000 Date Submitted: 5/08/02
Result: Awarded
Funded: $85,000 Period of Performance: 12 months

Title: Evaluation of Power Transformer Extender Technology
Sponsor: NEETRAC
Amount Requested: $150,000 Date Submitted: 5/08/02
Result: Awarded
Funded: $150,000 Period of Performance: 15 months

Title: Transmission and Substation Personnel Safety Ground Testing and Evaluation - Phase 3
Sponsor: NEETRAC
Co-P.I.(s): Shashi Patel
Amount Requested: $21,000 Date Submitted: 9/01/02
Result: Awarded
Funded: $21,000 Period of Performance: 12 months

Title: Field P/F Test for MOV Lightning Arresters
Sponsor: NEETRAC
Co-P.I.(s): Larry Coffeen
Amount Requested: $195,700 Date Submitted: 9/25/02
Result: Awarded
Funded: $195,700 Period of Performance: 18 months

Title: End of Life Failure Mode Investigation for Electronic Watthour Meters
Sponsor: NEETRAC
Co-P.I.(s): Ray Hill
Amount Requested: $71,000 Date Submitted: 9/25/02

Result: Awarded
Funded: $71,000 Period of Performance: 12 months

Title: Superconducting Fault Current Limiter
Sponsor: IGC SuperPower
Amount Requested: $39,100 Date Submitted: 11/01/02
Result: Awarded
Funded: $39,100 Period of Performance: 6 months

Title: Accelerated Aging Test for Vacuum Interrupters
Sponsor: NEETRAC
Co-P.I.(s): Tom Champion
Amount Requested: $98,000 Date Submitted: 1/15/03
Result: Awarded
Funded: $98,000 Period of Performance: 18 months

Title: Arrester Energy Handling Capability – Phase 2
Sponsor: NEETRAC
Co-P.I.(s): Ray Hill
Amount Requested: $68,500 Date Submitted: 1/15/03
Result: Awarded
Funded: $68,500 Period of Performance: 12 months

Title: IWC Bus/Non-Road Committee Representation
Sponsor: Georgia Power Company
Amount Requested: $33,424 Date Submitted: 04/01/03
Result: Awarded
Funded: $33,424 Period of Performance: 12 months

Title: Superhydrophobic Surface Coatings for Electrical Insulators
Sponsor: NEETRAC
Co-P.I.(s): Dr. C. P. Wong (MSE)
Amount Requested: $98,500 Date Submitted: 5/08/03
Result: Awarded
Funded: $98,500 Period of Performance: 15 months

Title: OH Line Surge Arrester Separation Distance
Sponsor: NEETRAC
Co-P.I.(s): Ray Hill
Amount Requested: $95,000 Date Submitted: 9/24/03
Result: Awarded
Funded: $95,000 Period of Performance: 15 months

Title: Separable Connector Field Problem Investigations
Sponsor: NEETRAC
Co-P.I.(s): Tom Champion

Amount Requested: $148,000 Date Submitted: 9/24/03
Result: Awarded
Funded: $148,000 Period of Performance: 18 months

Title: Stray Voltage Seminars
Sponsor: NRECA
Amount Requested: $12,915 Date Submitted: 12/19/03
Result: Awarded
Funded: $12,915 Period of Performance: 12 months

Title: Distributed Generation Screening Tool
Sponsor: Georgia Power Company
Co-P.I.(s): Dr. Miroslav Begovic
Amount Requested: $25,910 Date Submitted: 1/02/04
Result: Awarded
Funded: $25,910 Period of Performance: 12 months

Title: Commercialization of Field P/F Test Set for MOV Arresters
Sponsor: NEETRAC
Co-P.I.(s): Larry Coffeen
Amount Requested: $78,000 Date Submitted: 1/15/04
Result: Awarded
Funded: $78,000 Period of Performance: 12 months

Title: Padmounted Transformer Tank Temperatures
Sponsor: NEETRAC
Co-P.I.(s): Tim Andrews
Amount Requested: $97,900 Date Submitted: 1/15/04
Result: Awarded
Funded: $97,900 Period of Performance: 18 months

Title: Evaluation of OH Faulted Circuit Indicators
Sponsor: NEETRAC
Co-P.I.(s): Tom Parker
Amount Requested: $95,300 Date Submitted: 1/15/04
Result: Awarded
Funded: $95,300 Period of Performance: 18 months

Title: Superconducting Fault Current Limiter Development Program
Sponsor: NEETRAC
Amount Requested: $15,000 Date Submitted: 03/01/04
Result: Awarded

Funded: $15,000 Period of Performance: 9 months

Title: Contact Corrosion Investigation
Sponsor: Cooper Power Systems
Co-P.I.(s): Dr. Lisa Detter-Hoskins, GTRI
Amount Requested: $15,300 Date Submitted: 03/224
Result: Awarded
Funded: $15,300 Period of Performance: 6 months

Title: OH Loadbreak Switch Interrupters – Scoping Study
Sponsor: NEETRAC
Co-P.I.(s): Tom Champion
Amount Requested: $23,000 Date Submitted: 5/12/04
Result: Awarded
Funded: $23,000 Period of Performance: 6 months

Title: Optimization of Reactive Resources in T&D Networks – Phase 2
Sponsor: NEETRAC
Co-P.I.(s): Miroslav Begovic
Amount Requested: $145,000 Date Submitted: 5/12/04
Result: Awarded
Funded: $145,000 Period of Performance: 18 months

Title: Stray Voltage Concerns, Analysis, and Mitigation – Phase 2
Sponsor: NEETRAC
Co-P.I.(s): Shashi Patel
Amount Requested: $95,000 Date Submitted: 5/12/04
Result: Awarded
Funded: $95,000 Period of Performance: 18 months

Title: Standards & Methods for Dielectric Performance of Wildlife Guards & Deterrents – Phase 2
Sponsor: NEETRAC
Co-P.I.(s): Caryn Riley
Amount Requested: $120,000 Date Submitted: 5/12/04
Result: Awarded
Funded: $120,000 Period of Performance: 18 months

Title: Methods to Evaluate Lightning Performance of Substations – Scoping Study
Sponsor: NEETRAC
Co-P.I.(s): Shashi Patel
Amount Requested: $29,000 Date Submitted: 5/12/04
Result: Awarded
Funded: $29,000 Period of Performance: 6 months

Title: Communications Infrastructure for Electric System Automation
Sponsor: NEETRAC
Co-P.I.(s): Dr. Ian Akyildiz
Amount Requested: $141,300 Date Submitted: 5/12/04
Result: Awarded
Funded: $141,300 Period of Performance: 15 months

Title: EPRI IWC Committee Representation
Sponsor: Georgia Power Company
Amount Requested: $40,000 Date Submitted: 06/01/04
Result: Awarded
Funded: $40,000 Period of Performance: 12 months

Title: Harmonic Metering
Sponsor: NEETRAC
Co-P.I.(s): Dr. Ron Harley
Amount Requested: $24,500 Date Submitted: 8/01/04
Result: Awarded
Funded: $24,500 Period of Performance: 9 months

Title: Superhydrophobic Surface Coatings – Phase 2
Sponsor: NEETRAC
Co-P.I.(s): Dr. C. P. Wong (MSE)
Amount Requested: $150,000 Date Submitted: 9/16/04
Result: Awarded
Funded: $150,000 Period of Performance: 18 months

Title: Neutral Grounding Resistor Evaluation
Sponsor: PSE&G
Amount Requested: $23,600 Date Submitted: 10/25/04
Result: Awarded
Funded: $23,600 Period of Performance: 6 months

Title: Distribution Asset Management – Scoping Study
Sponsor: NEETRAC
Amount Requested: $38,200 Date Submitted: 2/02/05
Result: Awarded
Funded: $38,200 Period of Performance: 9 months

Title: Potential Application of Sensor Networks in Power Delivery
Co-P.I.(s): Dr. Deepak Divan
Sponsor: NEETRAC
Amount Requested: $51,500 Date Submitted: 2/02/05
Result: Awarded
Funded: $51,500 Period of Performance: 12 months

Title: Evaluation of Field Test Methods for SiC Arresters – Scoping Study
Co-P.I.(s): Larry Coffeen
Sponsor: NEETRAC
Amount Requested: $29,000 Date Submitted: 5/05/05
Result: Awarded
Funded: $29,000 Period of Performance: 8 months

Title: Evaluation of Direct Neutral vs. Pole Band Grounding
Co-P.I.(s): Shashi Patel
Sponsor: NEETRAC
Amount Requested: $79,000 Date Submitted: 5/05/05
Result: Awarded
Funded: $79,000 Period of Performance: 12 months

Title: Polymer Cutout Evaluation
Co-P.I.(s): Tom Champion
Sponsor: NEETRAC
Amount Requested: $248,000 Date Submitted: 5/05/05
Result: Awarded
Funded: $248,000 Period of Performance: 18 months

Title: OH Loadbreak Switch Interrupters
Co-P.I.(s): Tom Champion
Sponsor: NEETRAC
Amount Requested: $235,000 Date Submitted: 5/05/05
Result: Awarded
Funded: $235,000 Period of Performance: 18 months

Title: Dist. Ground Fault Impedance - Scoping Study
Co-P.I.(s): Shashi Patel
Sponsor: NEETRAC
Amount Requested: $33,500 Date Submitted: 9/25/05
Result: Awarded
Funded: $33,500 Period of Performance: 12 months

Title: Dist. Sensors for Dielectric Fluids - Scoping Study
Co-P.I.(s): Tom Champion
Sponsor: NEETRAC
Amount Requested: $39,800 Date Submitted: 9/25/05
Result: Awarded
Funded: $39,800 Period of Performance: 12 months

Title: Dist. Communications Infrastructure - Automation Phase 2
Co-P.I.(s): Dr. Ian Akyildiz
Sponsor: NEETRAC
Amount Requested: $135,000 Date Submitted: 9/25/05

Result: Awarded
Funded: $135,000 Period of Performance: 15 months

Title: Dist. Line Switch / OCB Arrester Separation Model Validation
Co-P.I.(s): Ray Hill
Sponsor: NEETRAC
Amount Requested: $79,500 Date Submitted: 9/25/05
Result: Awarded
Funded: $79,500 Period of Performance: 12 months

Title: Dist. Arc/Flash Hazards - T&D - Scoping Study
Sponsor: NEETRAC
Amount Requested: $38,500 Date Submitted: 1/25/06
Result: Awarded
Funded: $38,500 Period of Performance: 12 months

Title: Dist. Surge Arrester Disconnect Device Reliability
Co-P.I.(s): Ray Hill
Sponsor: NEETRAC
Amount Requested: $148,000 Date Submitted: 5/25/06
Result: Awarded
Funded: $148,000 Period of Performance: 15 months

Title: Stands. & Meths. for Eval. Dielec. Perf. Wildlife - Phase III
Co-P.I.(s): Caryn Riley
Sponsor: NEETRAC
Amount Requested: $225,000 Date Submitted: 5/25/06
Result: Awarded
Funded: $225,000 Period of Performance: 24 months

Title: Superhydrophobic Surface Coating - Phase III
Co-P.I.(s): Dr. C. P. Wong
Sponsor: NEETRAC
Amount Requested: $369,000 Date Submitted: 5/25/06
Result: Awarded
Funded: $369,000 Period of Performance: 36 months

Title: Ground Impedance Measuring Devices
Co-P.I.(s): Ray Hill
Sponsor: NEETRAC
Amount Requested: $119,000 Date Submitted: 9/25/06
Result: Awarded
Funded: $119,000 Period of Performance: 12 months

Title: Neutral to Earth Jacket Impulse Characteristics of Jackets
Co-P.I.(s): Dr. Sakis Meliopoulos

Sponsor: NEETRAC
Amount Requested: $115,000 Date Submitted: 9/25/06
Result: Awarded
Funded: $115,000 Period of Performance: 24 months

Title: Capacitor Bank Fuse Operation - Scoping Study
Sponsor: NEETRAC
Amount Requested: $35,000 Date Submitted: 1/25/07
Result: Awarded
Funded: $35,000 Period of Performance: 12 months

Title: Field Device Information Management & Integration - Scoping Study
Sponsor: NEETRAC
Amount Requested: $39,000 Date Submitted: 1/25/07
Result: Awarded
Funded: $39,000 Period of Performance: 12 months

Title: Fault Current Limiter & Power Flow Controller - Phase 1
Co-P.I.(s): Dr. Deepak Divan
Sponsor: NEETRAC
Amount Requested: $85,000 Date Submitted: 1/25/07
Result: Awarded
Funded: $85,000 Period of Performance: 15 months

Title: Optical Interferometric Sensor for DGA - Proof of Concept
Co-P.I.(s): Dan Campbell
Sponsor: NEETRAC
Amount Requested: $213,000 Date Submitted: 1/25/07
Result: Awarded
Funded: $213,000 Period of Performance: 24 months

Title: Feeder Voltage Phenomena - Phase I: Characterization
Co-P.I.(s): Dr. Sakis Meliopoulos
Sponsor: NEETRAC
Amount Requested: $89,000 Date Submitted: 1/25/07
Result: Awarded
Funded: $89,000 Period of Performance: 15 months

Title: Energy Harvesting for WSNs - Scoping Study
Co-P.I.(s): Dr. Deepak Divan
Sponsor: NEETRAC
Amount Requested: $60,000 Date Submitted: 5/25/07
Result: Awarded
Funded: $60,000 Period of Performance: 12 months

Title: Appl. and Perf. of TPG Systems - Handbook
Co-P.I.(s): Shashi Patel
Sponsor: NEETRAC
Amount Requested: $125,000 Date Submitted: 5/25/07
Result: Awarded
Funded: $125,000 Period of Performance: 18 months

Title: Distribution Insulator Performance Evaluation
Co-P.I.(s): Caryn Riley
Sponsor: NEETRAC
Amount Requested: $145,000 Date Submitted: 5/25/07
Result: Awarded
Funded: $145,000 Period of Performance: 18 months

Title: Overhead Cutout Failure Analysis - Porcelain Focus
Co-P.I.(s): Tom Champion
Sponsor: NEETRAC
Amount Requested: $150,000 Date Submitted: 5/25/07
Result: Awarded
Funded: $150,000 Period of Performance: 24 months

Title: AMI Applications for Power Delivery - Scoping Study
Sponsor: NEETRAC
Amount Requested: $39,000 Date Submitted: 9/21/07
Result: Awarded
Funded: $39,000 Period of Performance: 12 months

Title: Integral Disconnect Switches for Single Phase Meters
Co-P.I.(s): Ray Hill
Sponsor: NEETRAC
Amount Requested: $197,000 Date Submitted: 9/25/07
Result: Awarded
Funded: $197,000 Period of Performance: 24 months

Title: Next Generation PMUs / Evaluation
Co-P.I.(s): Dr. Sakis Meliopoulos
Sponsor: NEETRAC
Amount Requested: $169,000 Date Submitted: 1/21/08
Result: Awarded
Funded: $169,000 Period of Performance: 18 months

Title: 27 kV Polymer Cutout Evaluation
Co-P.I.(s): Caryn Riley
Sponsor: NEETRAC
Amount Requested: $420,000 Date Submitted: 5/21/08

Result: Awarded
Funded: $420,000 Period of Performance: 24 months

Title: Distribution Insulator Evaluation - Polymer Suspension
Co-P.I.(s): Caryn Riley
Sponsor: NEETRAC
Amount Requested: $210,000 Date Submitted: 5/21/08
Result: Awarded
Funded: $210,000 Period of Performance: 24 months

Title: Impact of New Load Types on T&D Systems
Co-P.I.(s): Dr. Deepak Divan
Sponsor: NEETRAC
Amount Requested: $129,000 Date Submitted: 5/21/08
Result: Awarded
Funded: $129,000 Period of Performance: 18 months

Title: Distribution Insulator Evaluation - Post Type
Co-P.I.(s): Caryn Riley
Sponsor: NEETRAC
Amount Requested: $240,000 Date Submitted: 5/21/08
Result: Awarded
Funded: $240,000 Period of Performance: 24 months

Title: Stick-on Current / Temperature Wireless Sensor
Co-P.I.(s): Dr. Deepak Divan
Sponsor: NEETRAC
Amount Requested: $99,000 Date Submitted: 9/21/08
Result: Awarded
Funded: $99,000 Period of Performance: 12 months

Title: Eval. of Direct Neutral vs. Pole Band Grounding -Phase 2
Co-P.I.(s): Shashi Patel
Sponsor: NEETRAC
Amount Requested: $129,000 Date Submitted: 9/21/08
Result: Awarded
Funded: $129,000 Period of Performance: 18 months

Title: Feeder Voltage Phenomena - Phase 2 - Mitigation
Co-P.I.(s): Dr. Sakis Meliopoulos
Sponsor: NEETRAC
Amount Requested: $156,000 Date Submitted: 1/28/09
Result: Awarded
Funded: $156,000 Period of Performance: 24 months

Title: Energy Storage in the Future Grid
Co-P.I.(s): Dr. Deepak Divan
Sponsor: NEETRAC
Amount Requested: $129,000 Date Submitted: 5/12/09
Result: Awarded
Funded: $129,000 Period of Performance: 18 months

Title: Capacitor Tank Rupture - Test Protocol Standardization
Co-P.I.(s): Carson Day
Sponsor: NEETRAC
Amount Requested: $93,000 Date Submitted: 5/12/09
Result: Awarded
Funded: $93,000 Period of Performance: 24 months

Title: Nuisance Fuse Operations - Phase I
Co-P.I.(s): Tom Champion
Sponsor: NEETRAC
Amount Requested: $117,000 Date Submitted: 5/12/09
Result: Awarded
Funded: $117,000 Period of Performance: 18 months

Title: On-line Condition Assessment of Aging CCVTs & Carrier Traps
Co-P.I.(s): Larry Coffeen
Sponsor: NEETRAC
Amount Requested: $242,000 Date Submitted: 9/25/09
Result: Awarded
Funded: $242,000 Period of Performance: 24 months

Title: Directional Hybrid Active Harmonic Filter
Co-P.I.(s): Dr. Deepak Divan
Sponsor: NEETRAC
Amount Requested: $190,000 Date Submitted: 9/25/10
Result: Awarded
Funded: $190,000 Period of Performance: 24 months

Title: Stick-on Wireless Sensor – Phase 2
Co-P.I.(s): Dr. Deepak Divan
Sponsor: NEETRAC
Amount Requested: $164,000 Date Submitted: 9/25/10
Result: Awarded
Funded: $164,000 Period of Performance: 24 months

Title: Conservation Voltage Reduction - Performance Assessment
Co-P.I.(s): Drs. Miroslav Begovic and Yamille del Valle

Sponsor: NEETRAC
Amount Requested: $185,000 Date Submitted: 1/28/11
Result: Awarded
Funded: $185,000 Period of Performance: 24 months

Title: Compact Dynamic Phase Angle Regulator for Transmission Power Routing
Co-P.I.(s): Drs. Santiago Grijalva and Rhett Major
Sponsor: ARPA-E
Amount Requested: $ 1,178,918 Date Submitted: 7/18/11
Result: Awarded
Funded: $1,178,918 Period of Performance: 36 months

Title: Distributed Power Flow Control using Smart Wires for Energy Routing
Sponsor: ARPA-E
Amount Requested: $ 486,323 Date Submitted: 11/21/11
Result: Awarded
Funded: $486,323 Period of Performance: 24 months

Title: Known Problems w/Porcelain Ins. for T&D - Scoping Study
Co-P.I.(s): Tom Champion
Sponsor: NEETRAC
Amount Requested: $53,000 Date Submitted: 5/23/12
Result: Awarded
Funded: $53,000 Period of Performance: 12 months

Title: Review of Non-Wood Pole Technologies
Co-P.I.(s): Tom Champion
Sponsor: NEETRAC
Amount Requested: $62,000 Date Submitted: 9/25/12
Result: Awarded
Funded: $62,000 Period of Performance: 12 months

Contracts Funded (P.I.)	$1,914,154
Contracts Funded (Co-P.I.)	$13,713,037
Total	$15,627,191

B. Published Journal Papers (refereed)

1. H. B. Püttgen, F. C. Lambert, and R. P. Webb, "High Voltage Techniques Course: A Cooperative Effort between Georgia Tech and Georgia Power", *IEEE Trans. on Power Systems*, vol. 2, no. 3, pp. 574-580, May 1988. Lambert was the Georgia Power representative who organized the laboratory component of the course.
2. A. H. Bingham, F. C. Lambert, M. R. Monashkin, C. B. DeLuca, and T. B.

Shaw, "An Accelerated Performance Test of Electrical Connectors", *IEEE Trans. on Power Delivery*, vol. 3, no. 2, pp. 762-768, April 1988. Lambert was the Georgia Power representative who chaired the Working Group on Accelerated Connector Testing for ANSI C119.4 and authored the paper for the committee.

3. Bass, R.M.; Handran, D.; Lambert, F.C.; Kennedy, J.R., "Olympic Electric Tram System: Power Quality and Power Electronics", *Power Electronics in Transportation*, 1996. IEEE , Page(s): 207 – 214. Lambert was project manager for the tram system and coordinated the data collection and analysis portion of the work.
4. Handran, D.; Bass, R.; Lambert, F.; Kennedy, J. , "Simulation of Distribution Feeders And Charger Installation For The Olympic Electric Tram System", *Computers in Power Electronics*, 1996, IEEE Workshop on, Page(s):168–175. Lambert was project manager for the tram system and coordinated the data collection and analysis portion of the work.
5. J. Mazumdar, R. Harley, F. Lambert and G.K. Venayagamoorthy, "A Novel Method for Predicting Harmonic Current Injection from Non-Linear Loads using Neural Networks," *IEEE Transactions on Industrial Electronics*, IECON 2005. 31st Annual Conference of IEEE, Nov. 2005. Lambert was co-inventor for IP and project manager.
6. J. Mazumdar, R. Harley, F. Lambert and G.K. Venayagamoorthy, "Intelligent Tool for Determining the True Harmonic Current Contribution of a Customer in a Power Distribution Network," *IEEE Transactions on Industry Applications,* Sept.-Oct. 2008, Page(s):1477 – 1485. Lambert was co-inventor for IP and project manager.
7. V. Cagri and F. Lambert, "A Survey on Communication Networks for Electric System Automation", *Computer Networks, Elsevier.* February 2006. Lambert was project manager.
8. R. Moghe, F. C. Lambert and D. Divan, "Novel Low Cost Smart Current Sensor for Utility Assets", *IEEE Transactions on Smart Grid*, Vol. 3, Issue 2, 2012. Lambert was co-inventor for IP and project manager.

B. <u>Published Papers (non-refereed)</u>

1. Püttgen, H. B., MacGregor, P.R., Lambert, F. C., "Distributed Generation: Semantic hype or the Dawn of a New Era?", *IEEE Power & Energy Magazine*, Volume 1, Issue 1, January – February 2003, pp. 22-29.

C. <u>Invited Conference Presentations</u>

1. Lambert, F. C., "Acoustic Emission Testing of Insulated Aerial Personnel Devices", *The Doble Conference*, Boston, Massachusetts, April 1984.
2. Lambert, F. C., "Professional Competence - How Continuing Education Can Help Us from Losing It", Panel Session at the *Summer Power Meeting of the Power Engineering Society*, Long Beach, California, July 12, 1989.

3. Lambert, F. C., "Electric Vehicle Recharging Infrastructure", "Clean Air Vehicle Conference", Atlanta, Georgia, April 11, 1995.
4. Lambert, F. C., "Designing Buildings to Accommodate Electric Vehicles", *Electric 95 Conference*, Atlanta, Georgia, June 8, 1995.
5. Lambert, F.C., "Distribution Automation: A Survey of Recent Advances", Panel Session at the *Summer Power Meeting of the Power Engineering Society*, Portland, Oregon, July 26, 1995.
6. Lambert, F. C., "Electric Transportation System for the Olympic Village", *DARPA Conference on Hybrid & Electric Vehicles*, Seven Springs, Pennsylvania, November 20, 1996.
7. Lambert, F. C., "Battery Management System Issues", *DARPA Conference on Hybrid & Electric Vehicles*, Honolulu, Hawaii, April 29, 1997.
8. Lambert, F. C., "Electric & Hybrid Vehicle Technology", *EPRI Electric Bus Users Group Workshop*, Dallas, Texas, June 20, 1997.
9. Lambert, F. C., "Rapid Charging and Battery Management for Heavy Duty Electric Vehicles", *Advanced Lead-Acid Battery Consortium Conference*, London, England, March 26, 1998.
10. Lambert, F.C., "Transmission and Substation Personnel Safety Ground Testing and Evaluation", *2000 IEEE 9th International Conference on Transmission & Distribution Construction, Operation, & Live-Line Maintenance*, October 11, 2000, Montreal, Quebec.
11. Patel, S. G. and Lambert, F. C., "Transmission and Substation Personnel Safety Ground Testing and Evaluation", *IEEE 2001 Winter Power Meeting, Joint Meeting of TPC (Tower, Poles, and Conductors) and ESMOL (Engineering, Safety, Maintenance, Operation of Lines)*, January 31st, 2001, Columbus, Ohio.
12. Lambert, F.C., "Trial-Use Guide for Testing the Electrical, Mechanical, and Durability Performance of Wildlife Guards and Deterrents Used on Overhead Power Distribution Systems", *IEEE Distribution Subcommittee*, June 7, 2004, Denver, Colorado.
13. Lambert, F.C., "Thermal And Temperature Cycling Tests on Solid Dielectric Switches, Interrupters, And Reclosers", *IEEE Switchgear Committee*, September 21, 2004, Tucson, Arizona.
14. Lambert, F.C., "End of Life Testing of Internal MOVs in Self Contained Electric Meters", *ANSI C12 Committee on Electricity Meters*, October 13, 2004, Minneapolis, Minnesota.
15. Lambert, F.C., "Standards for V2G Interconnection to the Grid", *Vehicle to Grid (V2G) Technical Symposium*, June 6, 2005, Seattle, Washington.
16. Lambert, F.C., "Swimming Pool Equi-potential Bonding", Working Group on Stray and Contact Voltages, *IEEE PES General Meeting*, Pittsburgh, PA, July 2008.
17. Lambert, F.C., "Polymer Cutout Evaluation", *IEEE Switchgear Committee*, October 2008, Calgary, Alberta.
18. Lambert, F.C., "Accelerated Weathering Testing of Loadbreak Switch Interrupters", *IEEE Switchgear Committee*, October, 2008, Calgary, Alberta.

19. Lambert, F. C. and Patel, S., "Exposure Voltages on Distribution Systems", NRECA Tech Advantage, Atlanta, GA, February 2009.
20. Lambert, F.C., "27 kV Polymer Cutout Evaluation", *IEEE Switchgear Committee*, May 2009, Asheville, NC.
21. Lambert, F. C., "Integral Disconnect Switches for Single-Phase Revenue Meters", *ANSI C12.1*, October 2010.
22. Lambert, F.C., "Electric Vehicle Deployment and Infrastructure Implications in the United States", *World Energy Council – Switzerland Chapter*, EPFL, Lausanne, Switzerland, March 2012.
23. Lambert, F. C., "Polymer Cutout Testing Recommendations", *IEEE Switchgear Committee*, May 2012, St. Petersburg, FL.

D. Conference Presentations with Proceedings (refereed)

1. Lambert, F. C. "The Managerial Issues Affecting Distribution Automation", *Conference Proceedings of the DA/DSM*, vol. 1, pp. 647-651, January 1994, Orlando, Florida.
2. Bass, R. M., Handran, D., Lambert, F.C., Kennedy, J. R., "Findings from the 1996 Olympic Games: Concentrated Charging and Power Quality", *Proceedings of the 1996 North American EV & Infrastructure Conference*, Vol. 1, December 12, 1996, San Diego, California. Lambert was responsible for the design and operation of the charging systems for the Electric Transportation System in the Olympic Village.

9. Bass, R. M., Handran, W. D., Abubaker, A. M., Lambert, F. C., and Kennedy, J. R., "Power Quality Impact of EV Charging on Utility Distribution Systems", *Proceedings of the 14th International Electric Vehicle Symposium*, December 16, 1997, Orlando, Florida. Lambert was project advisor and responsible for collecting power quality data from various electric vehicles.
10. Lambert, F.C., "Communications Modeling", *Proceedings of the 1998 North American EV & Infrastructure Conference*, Vol.1, December 3, 1998, Phoenix, Arizona.
11. Bass, R. M, Ronald Harley, Frank Lambert, Vinod Rajasekaran, Russell Davis, and Jason Pierce, "Secondary Distribution Harmonic Impacts of Residential EV Charging – Interim Report", *North American EV & Infrastructure Conference*, Vol.1, November 19, 1999, Atlanta, Georgia.
12. Richard Bass, Ronald Harley, Frank Lambert, Vinod Rajasekaran, and Jason Pierce, "Secondary Distribution Harmonic Impacts of Residential EV Charging", *Proceedings of the 17th International Electric Vehicle Symposium*, October 17th, 2000, Montreal, Quebec.
13. Richard Bass, Ronald Harley, Frank Lambert, Vinod Rajasekaran, and Jason Pierce, "Residential Harmonic Loads and EV Charging", *IEEE 2001 Winter Power Meeting*, January 30th, 2001, Columbus, Ohio.
14. Ronald Harley, Frank Lambert, Alisa Franklin, Pierre Clappier, Satish Rajagopalan, and McKinley Addy, "Power Quality Impacts of Airport GSE

Charging Systems", *IEEE 2003 Power Engineering Society General Meeting*, July, 2003, Toronto, Ontario.

15. Begovic, M.M., Radibratovic, B., Lambert, F.C., "On Multiobjective Volt-VAR optimization in Power Systems", *Proceedings of the 37th Annual Hawaii International Conference on System Sciences*, January 2004, pp. 59-64.
16. J. Mazumdar, R. Harley, T. Habetler and F. Lambert, "Using a neural network to discriminate between the contributions of the power electronic load and the power system to harmonic pollution", *Proceedings of the IEE International Power Electronics Conference (IPEC 2005)*, Niigata, Japan, pp. 874 – 878, April 4 – 8, 2005.
17. Joy Mazumdar, Ronald G Harley, Frank Lambert and Ganesh K. Venayagamoorthy, "Detection of Non-Linear Load Harmonics Using Neural Networks", *Proceedings of the International Conference on Power Systems Operation and Planning (ICPSOP 2005)*, Praia, Cape Verde, pp. 115 – 119, May 22 – 26, 2005.
18. J. Mazumder, R. G. Harley, F. Lambert, and G. K. Venayagamoorthy, "Using a neural network to distinguish between the contributions to harmonic pollution of non-linear loads and the rest of the power system", *Proceedings of the IEEE Power Electronics Specialist Conference (PESC05)*, pp. 1719-1725, Recife, Brazil, June 12- 16, 2005.
19. Joy Mazumdar, Ronald G Harley and Frank Lambert, "A Novel Method Based on Neural Networks to Distinguish Between Load Harmonics and Source Harmonics in a Power System", *Proceedings of the Inaugural IEEE Power Engineering Society 2005 Conference and Exposition in Africa (PES Durban 2005*), Durban, South Africa, July 11 – 15, 2005.
20. Joy Mazumdar and Ronald G. Harley and Frank Lambert, "System and Method for Determining Harmonic Contributions from Non-Linear Loads Using Recurrent Neural Networks", *Proceedings of the IEEE International Joint Conference on Neural Networks (IJCNN05*), Montreal, Canada, pp.366 - 371, July 31 – August 4, 2005.
21. Joy Mazumdar, R.G. Harley, and Frank Lambert, "System and Method for Determining Harmonic Contributions from Non-Linear Loads", *Proceedings of the 40th IEEE Industry Applications Society Annual Meeting (IAS 2005)*, 2-6 Oct. 2005, Hong Kong.
22. Joy Mazumdar, R. G. Harley and F. Lambert, " Identifying Harmonic Contributions from Non- Linear Loads Using Neural Networks", *Proceedings of the Intelligent Systems Applications in Power (ISAP) Conference*, November 7-10, 2005, Washington DC.
23. Joy Mazumdar, Ronald G Harley and Frank Lambert , "A Novel Method for Predicting Harmonic Current Injection from Non-Linear Loads Using Neural Networks", *Proceedings of the 31st Annual Conference of the IEEE Industrial Electronics Society (IECON'05)*, Raleigh, NC, November 7-10,. 2005.
24. J. Mazumdar, R. Harley, F. Lambert and G.K. Venayagamoorthy, "Predicting Load Harmonics in Three Phase Systems Using Neural

Networks," *Proceedings of the IEEE Applied Power Electronics Conference (APEC 2006)*, Dallas, Texas, Mar. 19 – 23, 2006.

25. Yi Yang; Lambert, F.; and Divan, D, "A Survey on Technologies for Implementing Sensor Networks for Power Delivery Systems", *IEEE Power Engineering Society General Meeting,* June 2007.
26. Rohit Moghe, Yi Yang, Deepak Divan and Frank Lambert, "A Scoping Study of Electric and Magnetic Field Energy Harvesting for Wireless Sensor Networks in Power System Applications", *IEEE Energy Conversion Congress and Expo,* San Jose, CA September 2009.
27. Debrup Das, Deepak Divan and Frank Lambert, "Integrated Fault Current Limiter and Power Flow Controller for Grid Tie-Lines", *IEEE Power Engineering Society General Meeting,* July 2009.
28. M. Steurer, B. Marchionini, F. Darman, F. Lambert and M. Noe, "Towards a Guide for Testing Emerging Fault Current Limiters", *CIGRE Session 2010*, Paris, August 2010.
29. Rohit Moghe, Yi Yang, Deepak Divan and Frank Lambert, "Design of a Low Cost
30. Self Powered "Stick-on" Current and Temperature Wireless Sensor for Utility Assets", *IEEE Energy Conversion Congress and Expo*, Atlanta, GA September 2010.
31. Frank Kreikebaum, Debrup Das, Yi Yang, Member, Frank Lambert and Deepak Divan, "Smart Wires – A Distributed, Low-Cost Solution for Monitoring Transmission Lines and Controlling Power Flows", *IEEE PES Innovative Smart Grid Technologies Conference Europe (ISGT Europe)*, 2010.
32. Rohit Moghe, Deepak Divan, Frank Lambert, "Powering Low-Cost Utility Sensors using Energy Harvesting", *Proceedings of the 2011-14th European Conference on Power Electronics and Applications (EPE 2011)*, September 2011.
33. Frank Kreikebaum, Dong Gu Choib, Frank Lambert, Valerie M. Thomas and Deepak Divan, "Increasing the Likelihood of Large-Scale Grid-Enabled Vehicle (GEV) Penetration through Appropriate Design Choices", *IEEE Vehicle Power and Propulsion Conference (VPPC)*, September 2011.
34. R. Moghe, A. Iyer, F. C. Lambert and D. Divan, "A Robust Smart Sensor for Smart Substations", *IEEE Power Engineering Society General Meeting,* July 2012.
35. Jorge E. Hernandez, Rajendra P. Kandula, Frank Lambert and Deepak Divan, "A Practical Directional Third Harmonic Hybrid Active Filter for Medium Voltage Utility Applications", *IEEE Energy Conversion Congress and Expo*, Raleigh, NC, September 2012.

II. TEACHING/INSTRUCTION/STUDENT DEVELOPMENT

A. <u>Continuing Education Courses Taught</u>

"High Voltage Engineering: Practices and Testing", September 23-27, 1996.

Lambert was a co-lecturer and was responsible for the laboratory sessions. Course evaluation data for Lambert was 86% Excellent and 14% Good. This course has been delivered in 1988, 1989, 1990, 1991, 1992, and 1993.

III. SERVICE

A. Professional Activities

1. President Elect, IEEE PES, 2018 – 2019.
2. VP Chapters, IEEE PES, 2014 – 2017.
3. Region 1-7 Representative, IEEE PES Governing Board, 2010 – 2013.
4. Chair, Region 3 PES Scholarship+ Committee, 2011 – 2016.
5. Member, Steering Committee, EPRI Electric Vehicle Infrastructure Working Council, 1997 - present.
6. Chairman, Plug-in Hybrid and Electric Vehicle Working Group, EPRI IWC, 2001 – present.
7. Secretary, IEEE PES Switching and Overcurrent Working Group, 2006 – 2012.
8. Secretary, IEEE PES Fault Current Limiter Testing Task Force, 2008 – 2016.
9. Member, CIGRE WG A3.23, Application and Feasibility of Fault Current Limiters in Power Systems, 2008 – 2012.
10. Member, IEEE PES Distribution Reliability Working Group, 2001-present.
11. Member, IEEE PES Working Group P1547.3 - Guide for Monitoring, Information Exchange and Control of Distributed Resources Interconnected with Electric Power Systems, 2002-2010.
12. Member, IEEE PES Distribution Automation (Smart Distribution) Working Group, 1992-present.
13. Member, IEEE PES Distribution Voltage Quality Working Group, 1995-2006.
14. Member, IEEE Power Engineering Career Promotion Subcommittee, 1992-2001.
15. Director, Atlanta Section IEEE, 1998-2000.
16. Chairman, SAE J2293 Electric Vehicle Charging Control Task Force, 1995-2001.
17. Chairman, Bus and Non-Road Charging Communication, Load Management, and Power Quality Committee, EPRI-IWC, 1997 - 2001.
18. Chairman, Charging Controls and Communication Committee, EPRI - Infrastructure Working Council, 1995-1999.
19. Secretary, Atlanta Section IEEE, 1997.
20. Director, Atlanta Section of IEEE, 1995-1996.
21. Finance Chair, IEEE Power Electronics PESC95 Conference, 1994-1995.
22. Chairman, Atlanta Chapter of IEEE Power Engineering Society, 1993-1995.
23. Vice-Chairman, Atlanta Chapter of IEEE Power Engineering Society, 1992-1993.
24. Secretary, Atlanta Chapter of IEEE Power Engineering Society, 1991-1992.
25. Treasurer, Atlanta Chapter of IEEE Power Engineering Society, 1990-1991.

26. Chairman, Custom Power Subcommittee, EPRI Custom Power Distribution Task Force, 1994.
27. Member, EPRI Distribution Task Force, 1992-1994.
28. Member, IEEE Digital Techniques in Electrical Measurements Subcommittee, 1983-1989.
29. Member, IEEE High Voltage Testing Techniques Subcommittee, 1982-1989.
30. Member, ANSI C119.4 Subcommittee on Overhead Connectors, 1983-1989.

B. On-Campus Committees

1. Welfare and Security Committee, Faculty of Georgia Tech, 1999-2005, Chairman 2003-2004 and 2004-2005.
2. Campus Master Plan Committee, 2003
3. Career Tracks Committee – GTRI, 2004-2005
4. AED Implementation Committee, Chairman 2005

C. Civic Activities

1. Chairman, Planning Commission, City of Chattahoochee Hills, 2008 - 2012
2. Member, Fulton County Board of Education, 1989-2002.
3. Member, South Fulton Chamber of Commerce, 1989-2002.
4. District Chairman, Boy Scouts of America, South Fulton District, 1998 – 2000.

IV. NATIONAL AND INTERNATIONAL PROFESSIONAL RECOGNITION

A. Honors and Awards

1. Chairman, IEEE Power Engineering Society Outstanding Chapter of the Year, 1994.
2. Senior Member, IEEE, 1987.

B. Professional Registration

1. Professional Engineer, State of Georgia, 1978.

C. Patents

U. S. Patent No. 7,013,227, “Method to Discriminate Between the Contributions of the Customer and the Power System to the Harmonic Disturbance”, Co-Inventors: Joy Mazumdar, Ron Harley, and Tom Habetler

U. S. Patent No. 7,722,951, “Insulator Coating and Method for Forming Same”, Co-Inventors: Jun Li, Lianhua Fan, and Ching-Ping Wong

Patents applied for:

1. "Durable Self Cleaning Superhydrophobic Surfaces with Application in External High Voltage Insulator Coatings", Co-Inventors: Yonghao Xiu, Lingbo Zhi, and Ching-Ping Wong
2. "Systems and Methods for Providing AC/DC Boost Converters for Energy Harvesting", Co-Inventors: Deepak Divan and Rohit Moghe
3. "Systems And Methods For Determining Current Flow Through A Utility", Co-Inventors: Deepak Divan and Rohit Moghe
4. "Self-Sustained Synchronous Rectifier", Co-Inventors: Deepak Divan and Ravi Nilakantan
5. "Multi-Core Triangulation Method for Current Sensing", Co-Inventors: Deepak Divan and Rohit Moghe
6. "A Low Cost Smart Voltage Sensor", Co-Inventors: Deepak Divan and Rohit Moghe

Invention disclosures:

1. "Method for Detection and Characterization of Fault Induced Delayed Voltage Recovery", Co-Inventors: Sakis Meliopoulos, George Cokkinides, Georgios Stefopoulos

D. Testimony before Legislative Committees

1. Lambert, F.C., "Superconductors and Electric Utility Applications", U.S. Congressional Briefing - Solving America's Electrical Problems: The Benefits of R&D, October 29, 2003, Washington, D.C.

E. Editorial and Reviewer Work for Technical Journals

1. Mr. Lambert periodically serves as reviewer for transactions grade papers submitted for publication in the IEEE Transactions on Power Delivery.

F. Expert Witness

1. Smith, Gambrell & Russell. LLP representing Blue Bird Body Company in a case involving performance of the electric drive system for their electric buses, 2000.
2. Quarles & Brady, LLP representing Meter-Treater, Inc. in a case involving failures of their meterbase surge arresters, 2001.
3. Jones, Cork& Miller LLP representing Georgia Power Company in a case involving a contact accident with a transmission line, 2005.

Statement of Support

By Burr C Passenheim

Subject: Proposed change in the National Electric Code (NEC)/NFPA 70 (Virginia Proposal T2701.1.1-18) to address risk of Electric Shock Drowning (ESD) at residential docks in Virginia.

I have reviewed the data, research and analysis developed by Mr. James Erler regarding ESD at residential docks. (http://erlerdesign.com/download/ESD_Review/) As an experienced expert in the design and analysis of electrical circuits and the underlying science surrounding electricity, and with particular experience in electrical grounding, I understand the materials that Mr. Erler has provided to me.

I agree with the following conclusions:

1. The grounding requirements in the 2017 NEC for residential docks form circuits that place intermittent voltages and currents on grounded dock structures that are sufficient to cause ESD injury or death.
2. Voltages and currents are delivered to grounded dock structures via the "green" ground conductor between the dock and house service panels.
    a. Claims by members of the National Fire Protection Association (NFPA) that the source of stray voltages/currents is some sort of current naturally flowing in the earth are false and not supported by scientific fact.
3. Grounded electrodes required in the NEC for installation at the house and dock are imperfect, resistive connections to the earth. The resistance of these connections to earth are too large to reduce the voltages on grounded structures to safe levels.
4. Removing the "green" ground conductor between the house and dock service panels removes the risk of ESD due to elevated ground voltages. There must be a separate earthed ground electrode at the dock that is connected to equipment ground. Equipment ground must NOT be connected to the neutral conductor from the electrical supply. In addition, all circuit breakers at the dock service panel must be 4 to 6 mA, personal protection, GFCIs.
    a. Claims by NFPA members that the "green" ground conductor is required for GFCIs to operate are false.
    b. Claims by NFPA members that GFCIs will not trip if there is a fault to a grounded structure connected to an earthed electrode are false.
    c. Statements in the NEC that the earth can never be used as a return conductor are correct when applied to neutral returns, but are incorrect when applied to ground fault interrupt devices such as GFCIs.
5. Between the 2014 NEC and the 2017 NEC, the requirement for 4 to 6 mA personal protection GFCI breakers was replaced with 30 mA equipment protection GFPE breakers. As ESD is caused by currents above 10 mA, this is a very dangerous change. All breakers at residential docks must be 4 to 6 mA personal protection GFCI breakers.

Name: Burr G Passenheim Date: 4/15/2020

Signature: Burr C Passenheim

Qualifications (please attach a resume/publications list or provide degrees and/or experience below):

PhD (physics) University of California (Riverside)

See Attached

Additional Comments:

BURR C. PASSENHEIM Ph.D.

3413 Rollsreach Dr
San Diego, CA 92111

Phone (858)737-4070 cell (505) 350-4996 e-mail passenheim@aol.com

RESUME

History:

General Atomic	1958-1965	Summer Employee
University of California at Berkeley	1959-1963	BA (Physics)
University of California at Riverside	1963-1968	MA/Ph.D. (Physics)
General Atomic	1968-1972	Research Scientist
IRT Corp.	1972-1978	Physics Group Leader
Mission Research Corporation	1978-1983	Group Leader
JAYCOR	1983-1994	Sr Principal Scientist
Journal Radiation Effects	1985-1986	Editor
Ingenuity Ink	1988-1990	Author/Publisher
San Diego State College	1994-1995	Post Grad Studies
Full Circle Research	1995-1998	Sr. Scientist
Maxwell Technologies	1998-2001	focal plane array testing
Science Applications Int Corp	2001-2005	Pulsed power facility

Areas of Expertise:

Radiation Effects	Device Physics	Cryogenics
Electromagnetics	Optics (UV-LWIR)	Magnetism
Electro-optics	Grounding/Shielding	Fast transient measurements
Data acquisition	Computer modeling	Technical Training
Technical marketing	Technical writing	Vacuum Technology
Inertial Instruments	Fiber optics	Detector technology

Science Applications International Corp.
Director of the Magnetic Flyer Plate (Pulsed power) Facility,
Developed end-to-end computer model.

Maxwell Technologies
Testing Infa-red focal plane assemblies.

Full Circle Research Senior Scientist
Single Event Testing
Designed and conducted optical and radiation tests of CCDs
Designed and conducted tests of shielded integrated circuit packages (RADPAK™)
Performed radiation transport and dose deposition calculations (ITS, SEA etc.)
Designed, built and used Roll Yaw apparatus to replicate omni-directional radiation.

JAYCOR: Senior Principal Scientist
Hardened and Tested Inertial Measurement Instruments.
Designed, built and tested optical instruments for nuclear tests.
Applied Electromagnetic shielding to Test equipment.
Characterized gas conductivity/plasma effects.
Analyzed fiber optic missile applications.
Measured fast optical phenomena (fi...

Invented and tested a radiation tolerant Photomultiplier.
Analyzed and tested Charge Coupled and MOS Devices.
Established Simulation Fidelity criteria for reentry vehicle radiation testing.
Determined consequence of interrupting interceptor missile guidance system.
Modeled and Tested magnetic thin film memories.
Served as Radiation Safety Officer.

Mission Research Corporation: Electromagnetics Group Leader

Designed and tested worlds most radiation tolerant photodiode.
Characterized spacecraft dielectric charging and discharging.
Characterized spacecraft "triggered" discharge.
Hardened and tested Ring Laser Gyroscopes to RV levels.
Hardened satellite-to-satellite laser communication system.
Established spectral fidelity of weapon simulator.
Designed test for air chemistry measurement.
Experimentally validated Nuclear Lightning initiation model.

General Atomic/IRT Corp: Research Scientist

Determined the effect of lithium on radiation damage to silicon.
Simulated nuclear radiation effects on magnetic materials.
Measured radiation effects on optical materials and fibers.
Developed model to explain optical radiation effects.
Devised technique to simulate thermo-mechanical effects.
Designed optical instruments for UV to LWIR applications.
Designed and Built Cryogenic (helium cooled) IR radiometer.
Built laser bi-directional reflectance apparatus (vis-LWIR).
Used ESR and IR spectroscopy to characterize radiation defects in solids.

University of California: Graduate Student

Developed technique to grow europium chalcogenide compounds.
Applied solid state physics models to magnetic compounds.
Measured low temperature heat capacity (0.3-20K) of magnetic materials.
Calibrated germanium resistance thermometer at ultra-low temperatures (T<1K).
Graded electromagnetics and taught mechanics Laboratory.
Operated Physics Dept. Computer and Wrote programs to do experiment data reduction..

Other Experience:

Performed experiments at more than 40 radiation test facilities.
Performed tests on six nuclear underground tests (UGTs).
Author of more than 40 publications and one book (How To Do Radiation Tests).

Reviewer of the **Journal of Radiation Effects** and **IEEE Trans Nuc Sci** (1975-95)
Editor of the **Journal of Radiation Effects** (1985-86).
Physics Instructor at San Diego City College (1970-71)
Member-at-Large Hardened Electronics and Radiation Tech.(HEART) Conference (1993-95)
Elected member of the IEEE Advisory Committee (1993-97)
Short Course Chairman 1988 HEART Conference
Clearances: DoD Secret and CNWDI, DoE Q.
Elected Senior Member of IEEE (1994)
Chairman: San Diego Chapter IEEE Nuclear and Plasma Sciences Society (1995-97)

BURR C. PASSENHEIM Ph.D.

3413 Rollsreach Dr
San Diego, CA 92111

Phone (858)737-4070 *cell (505) 350-4996* e-mail: passenheim@aol.com

"Magnetic Flier Plate Facility", with Darwin Brown. Scott Doane, and Neil Koozer **Journal of Radiation Effects, Research and Engineering**, V tbd ,pgs tbd, (2003).

"Compact X-Ray Simulator Design and Prototype Development" with K. Robertson, W. Rix, J. Rauch and A.R. Miller, to appear in **IEEE Trans Nuc Sci.** NS45, tbd, (1998)

"The Effects of Proton Irradiation on P-Channel CCD Imagers" with J.P. Spratt and R.E. Leadon, **1997 IEEE Radiation Effects Data Workshop** (1998)

"Effectiveness of IC Shielded Packages Against Space Radiation" with J.P. Spratt, R.E. Leadon, S. Clark and D. Strobel, to appear in **IEEE Trans Nuc Sci**, NS44, 2018, (1997)

"Radiation Testing Results of COTS Based Space Microelectronics" with Phil Layton, David Strobel, Hal Anthony, Robert Boss, Jim Marshall, John Parkinson and Jim Spratt to appear in **IEEE Trans Nuc Sci**, NS44, tbd, (1997)

"Gas Ionization Effects in Electronic Packages" with D.A. Walters, J.L. Sperling and G.E. Davis, to appear in **Journal of Radiation Effects, Research and Engineering**, V16 ,975. (1997)

"Gas Ionization Currents and IEMP in Integrated Circuit Packages" with D.A. Walters, H.A. Richeson, J.L. Sperling and G.E. Davis, **Journal of Radiation Effects, Research and Engineering**, V15, 56. (1995)

"Sensitivities of Predicted and Measured Box IEMP Responses to Details of Box Complexity and Radiation Exposure" with D. Walters, R. Leadon, D. Breuner, P. Coakley, C. Mallon and S. Lutjens, **Journal of Radiation Effects, Research and Engineering**, V14, tbd, (1995)

"Correlation of Digital and Analog Measurements of Box IEMP Upset in a Complex-Geometry Electronics Box" with D. Breuner, P. Coakley, R. Leadon, S. Lutjens, C. Mallon and D. Walters, **Journal of Radiation Effects, Research and Engineering**, V14,T.B.D. (1995)

"IEMP in High Density Interconnect Overlays; Analysis and Experiment" with R.E. Leadon, H. Richeson, T.M. Flanagan, Glen Forman, and James Loman, **Journal of Radiation Effects, Research and Engineering**, V12-3, 1, (Sept 1994)

"Evaluation of Radiation Induced Upset/Recovery of the Ground Based Interceptor Guidance Navigation and Control" with J. Wheeler, W. Seidler, J. Kulander, S. Gilardi, T. Ross and J.Pryor, **Journal of Radiation Effects, Research and Engineering**, V12-1A, 27, (1994)

"Experimental Evaluation of High Speed CCD Imager Radiation Effects Using Co60 and Proton Radiation" with T.L. Miller, D.A. Thompson, M.B. Elzinga, T.H. Lee, and R.E. Leadon, **1993 IEEE Radiation Effects Data Workshop,** 93TH0657-7, ISBN 0-7803-1906-0, 56, (1993).

"Radiation-Induced Transient Infrared Optical Effects in Sapphire, An Underground Test Measurement," with R. H. Stahl, C. E. Mallon, E. L. Follmer and H. Davis III, **Journal of Radiation Effects Research and Engineering**, Vol. 1R, 1990.

"Underground Testing (UGT) Spectrum Fidelity Issues for X-Ray-Induced IEMP and TREE Effects in Reentry Vehicle Electronics Subsystems," with W. Beezhold, D. E. Beutler, L. J. Lorence, W. P. Ballard, M. A. Hedemann, C. R. McClenahan, R. E. Craven, D. P. Knott, W. A. Seidler, **Journal of Radiation Effects Research and Engineering**, VIR, 1990.

"A Calculational Procedure for Gamma-Ray Box IEMP," with R. Leadon, D. Walters, W. Seidler, W. Beezhold and L. Lorence, **Journal of Radiation Effects Research and Engineering**, 7, 126, 1989.

"Characterization Limitations for Pulsed Bremsstrahlung Facilities," with W. Seidler, D. Walters, B. Kitterer, W. Beezhold, W. Ballard and D. Beutler, **Journal of Radiation Effects Research and Engineering**, V8, 1, 1989.

"Separating the Impact of IEMP and TREE Responses in a Simple Circuit," with D. Walters, W. Seidler, D. Breuner and A. Busdeker, **Journal of Radiation Effects Research and Engineering**, V8, 20, 1989.

"X-Ray Irradiation Simulation Fidelity Issues for Testing Reentry Vehicle Electronic Subsystems Using Harder-Than-Threat Aboveground Test Spectra: Part II," with W. P. Ballard, W. Beezhold, M. A. Hedemann, L. J. Lorence, Jr., C. R. McClenahan and W. A. Seidler, **Journal of Radiation Effects Research and Engineering**, V6, 58, 15 Dec 1988.

"A Radiation Tolerant Photodetector," with Robert O. Ginaven, **IEEE Trans. Nuc. Sci.**, 34, 1588, 1987.

"Variation of Box IEMP Response with Simulator Voltage," with W. Seidler, R. Kitterer, E. Wheatley, W. Beezhold, L. Lorence, Jr. and D. Shaeffer, **Journal of Radiation Effects Research and Engineering**, 5, 101, 1986.

"X-Ray Irradiation Simulation Fidelity Issues for Reentry Vehicle Electronic Subsystems," with W. Beezhold, L. J. Lorence, Jr., M. A. Stark, W. Seidler, B. Kitterer and D. L. Shaeffer, **Journal of Radiation Effects Research and Engineering**, 5, 146, 1986.

"Variation of Forward and Reverse Photoelectric Yield with Bremsstrahlung Energy," with

W. Seidler, B. Kitterer, W. Beezhold and M. Stark, **Journal of Radiation Effects Research and Engineering**, 5, 200, 1986.

"Limitations to the Stress Parameter Approach to Evaluating Simulation Fidelity," with W. Seidler, B. Kitterer and W. Beezhold, **Journal of Radiation Effects Research and Engineering**, 3, 1986.

"Progress in Nuclear-Induced Lightning," with J. D. Colvin, et al., **Journal of Radiation Effects Research and Engineering**, 2, 1, June 1984.

"X-Ray Triggered Discharge of Precharged Dielectrics," with J. D. Riddell, W. G. Vulliet, B. M. Goldstein and R. Stettner, **Journal of Radiation Effects Research and Engineering**, 2, 92, June 1984.

"Electrical Conductivity and Discharge in Spacecraft Thermal Control Dielectrics," with J. D. Riddell, V. A. J. van Lint and B. D. Kitterer, **IEEE Trans. Nuc. Sci.**, NS-29, 1594, 1982.

"Relating SGEMP Photon Test Exposures to Spacecraft Survivability Expectations," with V. A. J. van Lint and R. Stettner, **IEEE Trans. Nuc. Sci.**, NS-29, 1765, 1982.

"Charging and Discharging Teflon," with V. A. J. van Lint, Proceedings of the Spacecraft Technology Conference, 1980. **NASA Conf. Pub. 2182**, AFGL-TR-81-0270, 50, November 1980.

"Performance of Laser Systems in Radiation Environments,", with J. Holzer, **Optical Engineering**, 18, 562, December 1979.

"The Effect of Electron Precharging of SGEMP Response of Insulators," with V. A. J. van Lint, R. Stettner and D. A. Fromme, **IEEE Trans. Nuc. Sci.**, NS-26, 5024, December 1979.

"Monostatic and Bistatic Laser Reflectance of Engineering Materials," with J. T. Neu and R. S. Dummer, CLEOS "78", **IEEE/OSA Conference**, 7 February 1979.

"Nuclear Radiation Vulnerability of Ring Laser Gyroscopes," with C. E. Mallon, published by **SPIE Seminar Proceedings**, 157, 205, 1978.

" Radiation Effects on Optical Components," with M. J. Treadaway, **Society of Photo-Optical Instrumentation Engineers**, (Optics in Adverse Environments), 121, 67, 1977.

"Broadband Radioluminescence in Electron Radiation Ionic Compounds," with B. A. Green, **Journal of Applied Physics**, 48, 424, 1977.

"Radiation Coloration and Bleaching of Glass," with M. J. Treadaway, B. D. Kitterer and P. Schall, **IEEE Trans. Nuc. Sci.**, 23, 1852, 1976.

"Luminescence and Absorption of Electron Irradiated Common Optical Glasses, Sapphire and Quartz," with M. J. Treadaway and B. D. Kitterer, **IEEE Trans. Nuc. Sci.**, 22, 2253, 1975.

"IEMP in Plated-Wire Memories," with R. L. Fitzwilson, Proceedings of the AEC/DNA TREE/SGEMP Symposium, 14-17 January 1975.

"A Helium-Cooled Optical System for Low-Background Infrared Optical Measurements," with B. D. Kitterer, T. Flanagan, and R. Denson, **Rev. Sci. Instr.**, 45, 1365, 1974.

"Vulnerability of Magnetic Cores," with K. O. Downing, J. A. Naber, V. Kenyon, C. Vittoria and N. Tasslett, **Journal of Defense Research**, 2A, 563, 1972.

"Lithium - An Impurity of Interest in Radiation Effects in Semiconductors," **Radiation Effects**, 8, 239, 1971, same paper later appeared in Radiation Effects in Semiconductors, J. W. Corbett and G. D. Watkins (Eds), Gordon and Breach Science Publishers, 1971.

"Minority Carrier Lifetime Degradation and Anneal in Neutron-Irradiated Lithium-Diffused n-type Silicon," **Radiation Effects**, 2, 229, 1970.

"Production and Annealing of Defects in Lithium-Diffused Silicon After Irradiation with 30-MeV Electrons and Fission Neutrons at 300 C.," with J. A. Naber and R. A. Berger, **Proceedings of the Eighth Photovoltaic Specialists Conference**, August 1970. Published by the IEEE.

"Heat Capacity of RuO_2 and IrO_2 between 0.54 and 10 K," with D. C. McCollum, **Chem. Phys.**, 31, 320, 1969.

"Low-Temperature Heat Capacity of Europium Telluride," with D. C. McCollum, **Bull. Am. Phys. Soc.**, 13, 1645, 1968.

"Specific Heat of RuO_2 at Helium Temperatures," **Bull. Am. Phys. Soc.**, 13, 367, 1968.

"Low-Temperature Specific Heat of Arsenic," with D. C. McCollum, W. A. Taylor and H. W. White, **Phys. Rev.** 161, 652, 1967.

"Low-Temperature Specific Heat of EuS in a Magnetic Field," with D. C. McCollum and J. Callaway, **Phys. Letters**, 23, 634, 1966.

"Specific Heat of EuS at Liquid Helium Temperatures in a Magnetic Field," with

Statement of Support

By WILLIAM E. WHITLOCK

Subject: Proposed change in the National Electric Code (NEC)/NFPA 70 (Virginia Proposal T2701.1.1-18) to address risk of Electric Shock Drowning (ESD) at residential docks in Virginia.

I have reviewed the data, research and analysis developed by Mr. James Erler regarding ESD at residential docks. (http://erlerdesign.com/download/ESD_Review/) As an experienced expert in the design and analysis of electrical circuits and the underlying science surrounding electricity, and with particular experience in electrical grounding, I understand the materials that Mr. Erler has provided to me.

I agree with the following conclusions:

1. The grounding requirements in the 2017 NEC for residential docks form circuits that place intermittent voltages and currents on grounded dock structures that are sufficient to cause ESD injury or death.
2. Voltages and currents are delivered to grounded dock structures via the "green" ground conductor between the dock and house service panels.
    a. Claims by members of the National Fire Protection Association (NFPA) that the source of stray voltages/currents is some sort of current naturally flowing in the earth are false and not supported by scientific fact.
3. Grounded electrodes required in the NEC for installation at the house and dock are imperfect, resistive connections to the earth. The resistance of these connections to earth are too large to reduce the voltages on grounded structures to safe levels.
4. Removing the "green" ground conductor between the house and dock service panels removes the risk of ESD due to elevated ground voltages. There must be a separate earthed ground electrode at the dock that is connected to equipment ground. Equipment ground must NOT be connected to the neutral conductor from the electrical supply. In addition, all circuit breakers at the dock service panel must be 4 to 6 mA, personal protection, GFCIs.
    a. Claims by NFPA members that the "green" ground conductor is required for GFCIs to operate are false.
    b. Claims by NFPA members that GFCIs will not trip if there is a fault to a grounded structure connected to an earthed electrode are false.
    c. Statements in the NEC that the earth can never be used as a return conductor are correct when applied to neutral returns, but are incorrect when applied to ground fault interrupt devices such as GFCIs.
5. Between the 2014 NEC and the 2017 NEC, the requirement for 4 to 6 mA personal protection GFCI breakers was replaced with 30 mA equipment protection GFPE breakers. As ESD is caused by currents above 10 mA, this is a very dangerous change. All breakers at residential docks must be 4 to 6 mA personal protection GFCI breakers.

Name: WILLIAM E. WHITLOCK Date: 30 APRIL 2020

Signature: William E. Whitlock

Qualifications (please attach a resume/publications list or provide degrees and/or experience below):

SEE ATTACHED FILE: Whitlock RESUME v1.2.pdf

Additional Comments:

SEE ATTACHED FILE: Supplement to Whitlock Resume - ESD.pdf

Supplement to file: Whitlock RESUME v1.2.pdf

1. Under “Awards,” most of the honors listed were due to my extensive original research in, and knowledge of electronic system grounding – which, by default, is the equipment grounding conductor, or EGC, in the premises AC power distribution system. Since my training is in electronics, I very clearly understand the effects of multiple currents in EGC and external neutral and earth-ground conductors, the effects of magnetic induction in parallel circuit conductors, and an especially clear understanding of how GFCI devices actually work.

2. Under “Publications,” is a link to an example of the educational seminars I’ve presented for over 25 years. In those seminars, I explain how significant voltage differences are generated by earth to neutral connections in the external (to a building) AC power distribution system.

3. Several years ago, I served as consultant to the electrical contractor in modifying premises wiring for the purpose of minimizing voltage differences within the EGC network of the Bing Auditorium at Stanford University.

4. I’ve been very recently engaged to advise the electrical contractor in implementing the same voltage difference reduction in a new 90,000 sq ft test facility being built by Apple, Inc. in Cupertino, CA.

William E. Whitlock

30 April 2020

WILLIAM E. (BILL) WHITLOCK

642 College Drive, Ventura, CA 93003

Phone: (805) 755-5018, Mobile: (805) 890-7620, E-Mail: engineer_bill@verizon.net

SKILLS and CAREER SUMMARY

- **Skilled Analog & Mixed Signal Circuit Designer** (40+ years)
- **Experienced Technical Team Manager** (40+ years)
- **Signal Integrity & EMC Problem Solver** (25+ years)
- **Technical Writer & Instructor** (25+ years)

My circuit designs are often described as novel, simple, elegant, reliable, and cost-effective. I have a solid track record of innovation, including several patents, that has resulted in hugely successful products for my employers. In most cases, the products were the first of their kind – replacing industry "vaporware" with real hardware. Since 1972, my jobs have included managing a staff of other engineers and technicians, varying from 3 to 15, and routinely working with other engineering professionals such as PCB designers, software developers, purchasing, industrial designers, and marketing. I've often developed a product from concept to prototype.

Since 1995, I've become widely-known as the "guru of grounding" and system noise reduction – often solving noise problems that eluded other consultants. I'm a published technical writer, having created hundreds of product data sheets, application notes, and tutorials as well as writing book chapters, "white papers," and columns for trade magazines. Since 1994, I've created and presented technical tutorials to trade convention and university audiences worldwide. I've also held both secret and top-secret ("Q") security clearances over my career. I'm proficient with Microsoft Office (Word, Excel, Outlook, PowerPoint) and several schematic capture and circuit-simulation programs.

PROFESSIONAL EXPERIENCE

2014 – now Principal Engineer, Whitlock Consulting, 642 College Drive, Ventura, CA

I've done consulting as time permits, but only with employer approval, since 1970. Projects have included complete product designs (concept to prototype), circuit modifications, custom filters, product testing/evaluation, on-site troubleshooting/diagnosis of "ground-loop" noise issues, and basic feasibility research. A client list available on request.

1989 – 2014 President/Chief Engineer, Jensen Transformers, 9304 Deering Ave., Chatsworth, CA

In 1989, Jensen designed, manufactured, and distributed high-performance audio transformers for industry OEMs only. I inherited the company from colleague and company founder Deane Jensen upon his death in 1989. At the time, it had 6 employees, serious legal problems, and was deeply in debt. I revived it by creating a new plug-and-play product line, which incorporated the transformers, and found a much larger market. I also created new data sheets for the standard product line (about 100 models).

This included creating standard test circuits and parameter measurements, tutorial application notes, and over a hundred application schematics. When I sold Jensen in 2014, it had 16 employees, was debt-free, and enjoyed yearly revenues of nearly $2 million.

1981 – 1989 Manager of Electronic Development, Capitol Records, 1750 N. Vine St., Hollywood, CA

In 1981, Capitol Records was a highly vertically-integrated record label. They owned their own recording studios, manufactured their own vinyl records (including mastering lacquer discs), cassettes (including both tape and cassette shells), and compact discs, as well as a distribution arm. My department developed specialized electronics to upgrade performance of the recording, mastering, and high-speed cassette duplication signal chains. I managed a staff (2 other engineers, 3 technicians) to develop and manufacture electronics that were retrofitted into hundreds of cassette duplication machines in Capitol plants around the world as part of the XDR program. I also headed development of the first-ever digital "loop-bin" system, using a large RAM array to replace the high-speed (120"/sec) mechanical tape loop player in these systems – a frequent cause of factory down-time. I was also involved in developing QC instrumentation for Capitol's new CD manufacturing plants. I resigned when a newly-appointed Capitol CEO announced plans to phase-out most R&D operations.

1974 – 1981 Chief Engineer, Laser Images, Inc., 6911 Hayvenhurst Ave., Van Nuys, CA

I joined Laser shortly after its founding. It had 3 employees who produced it's "Laserium" laser light show, using hand manipulation of optical "devices," at Griffith Park planetarium in Los Angeles. They asked me to develop automation electronics to control the optical devices in the laser projector. In the course of this work, I developed and patented a digital audio recording system based on modified VHS tape players. I also developed one of the first high-efficiency "class-D" power amplifiers using newly-introduced power MOSFETs to drive optical scanning devices. The automated projectors allowed rapid expansion of show venues (over 20 of the world's largest planetariums) and hiring 100 new employees by the late 70's. A series of upper management blunders crippled the business by 1980 … and I resigned.

EDUCATION

1963 – 1965 Pinellas Technical College, Clearwater, FL – Associate in Electronics Technology

When I enrolled, this school had just opened, but became fully accredited shortly after my graduation.. The electronics technology program consisted of 6 trimesters, but I took final exams for the first two trimesters, hastening my graduation. The curriculum included related courses such as chemistry, strength of materials, micro-assembly, and public speaking. Due to my work experience as a bench TV service technician, my professor let me teach TV technology in my last trimester. I graduated with honors in 1965.

1962 – 1963 St. Petersburg Junior College, St. Petersburg, FL – (no degree)

I enrolled in the engineering program but dropped out in the second semester because I was frustrated with taking courses like English literature and other non-engineering requisites. I was perhaps overly anxious to take "real" engineering classes and dropped out in my 3rd semester.

1960 - 1962 Northeast High School, St. Petersburg, FL - Diploma

Following the launch of Sputnik in 1957, the Florida school system started an "Accelerated Arts and Sciences" program. For the first time, students could take chemistry, physical science, Algebra I through III, plane geometry, and solid geometry in high school. I opted into the program and made excellent grades. I also had the 5th highest SAT score among about 200 graduating seniors.

AWARDS

2012 Audio Engineering Society Life Fellow Award

Because of my body of work, especially in advancing the industry's knowledge of grounding, shielding, and signal integrity issues, I was awarded Fellow status.

2010 NSCA Technical Instructor of the Year Award … and again in 2011

Awarded by the National System Contractor Association (NSCA) by a vote of students who attended dozens of technical seminars at the annual NSCA conventions.

2009 Institute of Electrical & Electronic Engineers Life Senior Status

Because of my body of industry knowledge contributions, I was advanced to Senior member.

2007 Invited Lecturer at MIT

My lecture was about "Grounding" and its implications at both the circuit and system level. I did several lectures the same day, first to two classes of EE students and, in the evening, to a broader audience of about 300, including a number of physics and electronics professors … who unanimously admitted that their own coverage of this fundamental topic was rather superficial.

OTHER TECHNICAL ACTIVITIES

2008 Underwriter's Laboratory Advisory Panel Member

I was invited to join this advisory group on professional audio equipment and I'm still intermittently involved in approvals of proposed new safety standards and/or revisions of existing ones.

1995 AES and IEC Standards Organizations

The Audio Engineering Society creates and maintains standards for the industry. I remain an active member of SC-05-05, the working group on Grounding and Shielding, and was its chairman for several years.

In 1999, the IEC (perhaps the largest standards organizations in the world) put out a "call for comment" on their Standard 60268-3, a test for common-mode rejection in balanced interfaces. Test results seemed to have little correlation with real-world results. I suggested procedural changes that were adopted by the IEC in 2000.

1966 Institute of Electrical & Electronic Engineers Membership

I became very interested in the knowledge base of the IEEE in college. Over the years, I've been a member of several IEEE "societies" such as solid-state circuits, circuits and systems, electromagnetic compatibility, and others. I've presented tutorials to local IEEE chapters several times and continue to be an active member.

1966 Audio Engineering Society Membership

I have a very long-standing interest in music and the technical side of its production and reproduction. I joined the AES in college and became quite active in 1972, after getting my first job in the professional audio industry. I continue to actively participate in national conventions and local chapter activities, including tutorial presentations.

PATENTS

2012 RCA-Compatible Connectors for Balanced and Unbalanced Interfaces, US Pat 8,100,715

So-called "RCA" connectors are the de-facto standards in consumer audio equipment. This patent describes a 3-contact male and female connector that are physically compatible with existing 2-contact versions. The cable then is a shielded, twisted pair with the invented 3-contact male plugs at each end. The added contact is arranged so that it, along with the center-pin, become the balanced signal pair but, when connected to a conventional 2-RCA-compatible mate, the "low' side of the balanced line is tied to the "ground" contact automatically. This enables the noise rejection properties of a balanced line even when the signal source is a conventional unbalanced output and 2-contact connector. Of course, maximum benefit is achieved when both output and input sockets are 3-contact balanced types described in the patent.

https://patents.google.com/patent/US8100715

2011 Power Cable with Twisted and Untwisted Wires … US 2012/0103646A1 (provisional)

My colleague Jamie Fox, an electrical power engineer, is co-inventor. The wire arrangement minimizes magnetic coupling between current-carrying conductors and safety-ground conductor, thus minimizing voltage induced into the ground conductor and, subsequently, the system equipment grounds. It is this voltage that is the root-cause of "ground loop" issues.

http://www.patentsencyclopedia.com/imgfull/20120103646_01

1998 Continuous Feed-Forward AC Voltage Regulator, US Pat 6,653,824

This invention is an AC voltage regulator which includes a feed-forward circuit and a differential amplifier that continuously compares the incoming AC voltage to a locally-generated, amplitude-stabilized, and phase-locked reference waveform. The output of the differential amplifier drives a power amplifier whose output is arranged to continuously buck or boost the incoming AC voltage. This corrects both the amplitude and waveform distortions, creating a pure waveform and constant output voltage.

https://patents.justia.com/patent/6653824

1994 Differential Line Receiver with Common-Mode AC Bootstrapping, US Pat 5,561,561

A bootstrapped audio line receiver that receives a differential-mode input signal and outputs a single-ended signal. The inputs provide a DC current path to a ground terminal while maintaining a very high input common-mode impedance to AC signals. The inputs include a bootstrapped RF filter that removes RF noise without adversely affecting common-mode rejection at audio frequencies. In one embodiment, the input amplifier includes two operational amplifiers connected for unity gain and having two bias resistors connected in series between each input terminals of the input amplifier and a ground terminal. A capacitor is connected from the output of each operational amplifier to a node between each set of series connected bias resistors and prevents the low impedance of the bias resistors from significantly degrading the line receiver's common-mode rejection ratio. Thus, the line receiver tolerates a wide range of balanced and unbalanced sources with a minimal deterioration of the line receiver's CMRR.

https://patents.google.com/patent/US5568561A/en

1977 Pulse Code Modulated Digital Audio System, US Pat 4,030,129

The patent describes a method of using a rotary-head tape transport (as in VHS and Betamax video recorders) to record and playback digitized serial PCM-encoded audio signals and auxiliary data. Data formatting and framing circuits are described that minimize the effects of the timing irregularities peculiar to such tape transports as well as a novel method of concealing the effects of "drop-outs" they are also prone to.

https://patents.google.com/patent/US4030129A/en

PUBLICATIONS

1995 "Balanced Lines in Audio Systems: Fact, Fiction, and Transformers"

Journal of the Audio Engineering Society

The theoretical benefits of balanced audio interconnection schemes are discussed as well as fundamental but widely unrecognized mechanisms that limit real-world performance. The venerable audio transformer enjoys several inherent advantages over the so-called active circuits offered to replace it in audio equipment. Today, as improved digital recording systems demand increased system dynamic range, these advantages are becoming ever more important.
https://www.researchgate.net/publication/294765837_Balanced_lines_in_audio_systems_fact_fiction_and_transformers

2015 "Handbook for Sound Engineers," 5th edition *(also 3rd and 4th editions)*

Focal Press

Handbook for Sound Engineers is the most comprehensive reference available for audio engineers, and is a must read for all who work in audio. With contributions from many of the top professionals in the field, including Glen Ballou on interpretation systems, intercoms, assistive listening, and fundamentals and units of measurement, David Miles Huber on MIDI, ***Bill Whitlock on audio transformers and preamplifiers***, Steve Dove on consoles, DAWs, and computers, Pat Brown on fundamentals, gain structures, and test and measurement, Ray Rayburn on virtual systems, digital interfacing, and

preamplifiers, Ken Pohlmann on compact discs, and Dr. Wolfgang Ahnert on computer-aided sound system design and room-acoustical fundamentals for auditoriums and concert halls, the Handbook for Sound Engineers is a must for serious audio and acoustic engineers.
https://www.academia.edu/38318764/handbook-for-sound-engineers-pdf_8993935.pdf

1998-2003 "Clean Signals" Column

Sound & Video Contractor Magazine

As indicated at the URL below, this column in a very popular trade magazine covered a wide range of signal interfacing issues. Between 1995 and 2014, I wrote for many other magazines as well.
https://www.svconline.com/author/bill-whitlock

2009 "Hum, Buzz, and Ground Loops: New Insights into an Old Problem" Seminar Presentation

I've presented at least 100 seminars on this general topic at trade show conventions, universities, and large companies from 1994 to the present. PowerPoint slides from a typical seminar can be found at: http://centralindianaaes.files.wordpress.com/2012/09/indy-aes-2012-seminar-w-notes-v1-0.pdf Live video excerpt from a presentation in Berlin can be found at: http://www.aes.org/live/?ID=218

Bill Whitlock

Principal Engineer

Whitlock Consulting

642 College Drive
Ventura, CA 93003
E-mail: engineerbill@ieee.org
Office: (805) 755-5018
Mobile: (805) 890-7620

Audio Engineering Society Life Fellow

IEEE Life Senior Member

ANALOG CIRCUIT DESIGN
ANALOG SIGNAL INTERFACING
ELECTRONIC PRODUCT DESIGN

40+ Years of Innovative Design Experience

- Product Design from Concept to Prototype
- Advanced Knowledge of Grounding & AC Power
- Troubleshooting of System Noise Problems
- Extensive Background in Professional Audio
- Member of UL Advisory Committee on Pro Audio
- Specialty Filters and Signal Processing Circuitry
- Design Reviews and Failure Analysis
- Technical Writing and Teaching
- 5 US Patents

Statement of Support

By RONALD M BAUMAN

Subject: Proposed change in the National Electric Code (NEC)/NFPA 70 (Virginia Proposal T2701.1.1-18) to address risk of Electric Shock Drowning (ESD) at residential docks in Virginia.

I have reviewed the data, research and analysis developed by Mr. James Erler regarding ESD at residential docks. (http://erlerdesign.com/download/ESD_Review/) As an experienced expert in the design and analysis of electrical circuits and the underlying science surrounding electricity, and with particular experience in electrical grounding, I understand the materials that Mr. Erler has provided to me.

I agree with the following conclusions:

1. The grounding requirements in the 2017 NEC for residential docks form circuits that place intermittent voltages and currents on grounded dock structures that are sufficient to cause ESD injury or death.
2. Voltages and currents are delivered to grounded dock structures via the "green" ground conductor between the dock and house service panels.
    a. Claims by members of the National Fire Protection Association (NFPA) that the source of stray voltages/currents is some sort of current naturally flowing in the earth are false and not supported by scientific fact.
3. Grounded electrodes required in the NEC for installation at the house and dock are imperfect, resistive connections to the earth. The resistance of these connections to earth are too large to reduce the voltages on grounded structures to safe levels.
4. Removing the "green" ground conductor between the house and dock service panels removes the risk of ESD due to elevated ground voltages. There must be a separate earthed ground electrode at the dock that is connected to equipment ground. Equipment ground must NOT be connected to the neutral conductor from the electrical supply. In addition, all circuit breakers at the dock service panel must be 4 to 6 mA, personal protection, GFCIs.
    a. Claims by NFPA members that the "green" ground conductor is required for GFCIs to operate are false.
    b. Claims by NFPA members that GFCIs will not trip if there is a fault to a grounded structure connected to an earthed electrode are false.
    c. Statements in the NEC that the earth can never be used as a return conductor are correct when applied to neutral returns, but are incorrect when applied to ground fault interrupt devices such as GFCIs.
5. Between the 2014 NEC and the 2017 NEC, the requirement for 4 to 6 mA personal protection GFCI breakers was replaced with 30 mA equipment protection GFPE breakers. As ESD is caused by currents above 10 mA, this is a very dangerous change. All breakers at residential docks must be 4 to 6 mA personal protection GFCI breakers.

Name: Ronald M Bauman Date: 30 April 2020

Signature: Ronald M Bauman

Qualifications (please attach a resume/publications list or provide degrees and/or experience below):

BSEE LEHIGH UNIVERSITY 1963
DARPA PROGRAM MANAGER
CEO INSOUND AUDIO INC - manufacturer of high end audio equipment
may contact me if necessary: insound@insoundaudio.com

Additional Comments:

Agree that the current codes need to change especially with regard to water safety. The proposed changes appear to be based on sound engineering analysis. The safety of current codes needs to be tested by a group of objective engineers.

Statement of Support

By Robert A. Lowell

Subject: Proposed change in the National Electric Code (NEC)/NFPA 70 (Virginia Proposal T2701.1.1-18) to address risk of Electric Shock Drowning (ESD) at residential docks in Virginia.

I have reviewed the data, research and analysis developed by Mr. James Erler regarding ESD at residential docks. (http://erlerdesign.com/download/ESD_Review/) As an experienced expert in the design and analysis of electrical circuits and the underlying science surrounding electricity, and with particular experience in electrical grounding, I understand the materials that Mr. Erler has provided to me.

I agree with the following conclusions:

1. The grounding requirements in the 2017 NEC for residential docks form circuits that place intermittent voltages and currents on grounded dock structures that are sufficient to cause ESD injury or death.
2. Voltages and currents are delivered to grounded dock structures via the "green" ground conductor between the dock and house service panels.
    a. Claims by members of the National Fire Protection Association (NFPA) that the source of stray voltages/currents is some sort of current naturally flowing in the earth are false and not supported by scientific fact.
3. Grounded electrodes required in the NEC for installation at the house and dock are imperfect, resistive connections to the earth. The resistance of these connections to earth are too large to reduce the voltages on grounded structures to safe levels.
4. Removing the "green" ground conductor between the house and dock service panels removes the risk of ESD due to elevated ground voltages. There must be a separate earthed ground electrode at the dock that is connected to equipment ground. Equipment ground must NOT be connected to the neutral conductor from the electrical supply. In addition, all circuit breakers at the dock service panel must be 4 to 6 mA, personal protection, GFCIs.
    a. Claims by NFPA members that the "green" ground conductor is required for GFCIs to operate are false.
    b. Claims by NFPA members that GFCIs will not trip if there is a fault to a grounded structure connected to an earthed electrode are false.
    c. Statements in the NEC that the earth can never be used as a return conductor are correct when applied to neutral returns, but are incorrect when applied to ground fault interrupt devices such as GFCIs.
5. Between the 2014 NEC and the 2017 NEC, the requirement for 4 to 6 mA personal protection GFCI breakers was replaced with 30 mA equipment protection GFPE breakers. As ESD is caused by currents above 10 mA, this is a very dangerous change. All breakers at residential docks must be 4 to 6 mA personal protection GFCI breakers.

Name: Robert A. Lowell Date: April 12, 2020

Signature: Robert A Lowell

Qualifications (please attach a resume/publications list or provide degrees and/or experience below):

PDF's of Resume and work history:
EMP, SGEMP and EMC Mitigation

Additional Comments:

At TRW (Redondo Beach, CA, was responsible for developing and qualifying by lab tests the effectiveness of grounding & shunting measures to protect satellites against EMP, EMI & SGEMP

1.1.1 Robert A. Lowell

Education and Certifications

Graduate Courses in Satellite Communications, Electromagnetics, USC, 1979-82
MS Physics - Northeastern Univ ABD, 1972-75
BS Physics – Worchester Polytechnic Institute, 1969

Security Clearances **: TS/SCI, CNWDI**

Title : Senior Radiation Scientist

Years of relevant Experience **: 47**

Developed the first Flash Xray machines and performed the first SGEMP and IEMP experiments to understand and model the phenomena over a full range of cavity dimensions and air pressures (1972-4). Developed the first cable SGEMP database for TRW (1974-6). Developed the first Xray hardened cable (w Raychem). Used these SGEMP and IEMP models at TRW (1977-82) to construct full system response models of AF/Navy/OGA satellites, including DSP 14, Milstar, SBIRS High. Pioneered development of a combined SGEMP/TREE satellite model for full 3D representation of spacecraft with solar arrays and antenna's, focusing on the energy coupled into the system from all effects simultaneously. Developed hardening solutions for structural shielding and mitigation schemes for payload aperture and thermal penetrations.

Was an integral part of the SENSOR UGT Team that fielded the Hunter's Trophy experiment on an 8 deg K Homing Sensor to demonstrate Operate Through for sensor systems at very high Xray fluence levels (classified). Documented knowledge in the Sensor Hardening Protocol (1993-96). Was specifically responsible for the design and validation of the EM shielding of the Homing Interceptor structure in concert low response cable and connector design and fabrication.

At Northrop Electonics, headed a group focused on radiation analysis, support of design hardening, and verification of MX Missile Inertial Measurement Unit. Lead test team for Xray OT and Survive threshhold verification at Aurora FXR and performed flyout simulations to prove missile Delta CEP requirements were met in presence of multiple nuclear bursts. At Kaman Sciences, as sub to Northrop Advanced Systems Div, managed the nuclear assessment, hardening and verification of the B2 bomber against TREE, EMP and Human effects. Personally wrote the detailed requirements and test plan for box, subsystem and system-level EMP verification testing – the latter not actually performed until the system went operational.

Awards and Honors:

Accommodation letter from Gen Kritikowski (MilStar AF PM) for verifying the MilStar satellite SGEMP thresholds for Upset and Burnout (1991),indicating adequate System-level Xray test (>$20M)

Relevant Publications:

1) Gamma SGEMP Hardening Handbook for Army HDL, 1988
2) Box IEMP Hardening Handbook for DTRA (lead Author), 1991
3) Passive Sensor Hardening and Validation Protocol, 1996
4) For Industry, lead author on the Satellite Nuclear Hardening Handbooks for TRW (1982), and as a consultant, subsequent Handbooks: Lockheed (FEWS-SBIRS); Boeing (TSAT, 2007-2008)

5) Multiple JRE papers on Nuclear Modeling, Hardening and Verification Testing of Communications (FSC,Milstar) and Surveillance Satellites (SSTS, SBIRS,SBSS), 1988-1997

Statement of Support

By Douglas Dorr

Subject: Proposed change in the National Electric Code (NEC)/NFPA 70 (Virginia Proposal T2701.1.1-18) to address risk of Electric Shock Drowning (ESD) at residential docks in Virginia.

I have reviewed the data, research and analysis developed by Mr. James Erler regarding ESD at residential docks. (http://erlerdesign.com/download/ESD_Review/) As an experienced expert in the design and analysis of electrical circuits and the underlying science surrounding electricity, and with particular experience in electrical grounding, I understand the materials that Mr. Erler has provided to me.

I agree with the following conclusions:

1. The wiring requirements in section 555 of the 2017 NEC for residential docks form circuits that place intermittent voltages and currents on grounded dock structures that are sufficient to cause ESD injury or death.
2. Voltages and currents are delivered to grounded dock structures via the "green" ground conductor between the dock and house service panels.
3. Removing, disconnecting or isolating the "green" ground conductor between the house and dock service panels removes the risk of ESD due to elevated ground voltages. There must be a separate earthed ground electrode at the dock that is connected to equipment ground. Equipment ground must NOT be connected to the neutral conductor from the electrical supply. In addition, all circuit breakers at the dock service panel must be 4 to 6 mA, personal protection, GFCIs.
4. Claims by members of the National Fire Protection Association (NFPA) that the source of stray voltages/currents is some sort of current naturally flowing in the earth are false and not supported by scientific fact.
5. Grounded electrodes required in Section 555 of the NEC for installation at the house and dock do not reduce the current into the water and the associated shock hazard. The resistance of these connections to earth are too large to reduce the voltages on grounded structures to safe levels.
6. Claims by NFPA members that the "green" ground conductor is required for GFCIs to operate are false.
7. Claims by NFPA members that GFCIs will not trip if there is a fault to a grounded structure connected to an earthed electrode are false.
8. Statements in the NEC that the earth can never be used as a return conductor are correct when applied to neutral returns, but are incorrect when applied to ground fault interrupt devices such as GFCIs.

9. Between the 2014 NEC and the 2017 NEC, the requirement for 4 to 6 mA personal protection GFCI breakers was replaced with 30 mA equipment protection GFPE breakers. As ESD is caused by currents above 10 mA, this is a very dangerous change. All breakers at residential docks must be 4 to 6 mA personal protection GFCI breakers.

Name: Douglas Dorr Date: 04/21/2020

Signature: 

Qualifications (please attach a resume/publications list or provide degrees and/or experience below):
Douglas Dorr is a Technical Executive with the Electric Power Research Institute. For the past 25 years Mr. Dorr has been involved in Electric Power System research and development with a special focus on stray and contact voltage shock and perception investigations. Mr. Dorr has participated in over fifty electric shock investigations at swimming pools, boat docks, marinas, confined livestock areas and power distribution system contact points. He has authored well over a dozen peer reviewed papers and guidebooks on stray voltage, contact voltage, equipotential bonding and wiring and grounding topics. He has also developed specialized test and measurement equipment and procedures to support field investigators. As a Senior Member of the IEEE, Mr. Dorr chaired the most recent revision to the IEEE Emerald Book – Recommended Practice for Powering and Grounding Electronic Equipment and he is the long time Chair for the IEEE SPDC 3.6.4 Working Group on Characterization of the Lightning and Surge Environment. Mr. Dorr received a Bachelor's degree in Engineering from Indiana Institute of Technology in 1989.

Additional Comments:

Relative to item 3 (removing, disconnecting, or isolating the green wire between the dock sub panel and the main service - this precedent is already established by NEC article 406 (for ungrounded branch circuits). The proposal extends the concept to a sub panel application. In any case, regardless of the means (i.e. removal, isolation or disconnecting) proper labeling and properly rated GFCI protection would be required. It should additionally be noted that for the proposed implementation GFCI protection is required at both the main service panel and at each breaker for the dock equipment.

Statement of Support

By FRANK C. LAMBERT, P.E.

Subject: Proposed change in the National Electric Code (NEC)/NFPA 70 (Virginia Proposal T2701.1.1-18) to address risk of Electric Shock Drowning (ESD) at residential docks in Virginia.

I have reviewed the data, research and analysis developed by Mr. James Erler regarding ESD at residential docks. (http://erlerdesign.com/download/ESD_Review/) As an experienced expert in the design and analysis of electrical circuits and the underlying science surrounding electricity, and with particular experience in electrical grounding, I understand the materials that Mr. Erler has provided to me.

I agree with the following conclusions:

1. The grounding requirements in the 2017 NEC for residential docks form circuits that place intermittent voltages and currents on grounded dock structures that are sufficient to cause ESD injury or death.
2. Voltages and currents are delivered to grounded dock structures via the "green" ground conductor between the dock and house service panels.
    a. Claims by members of the National Fire Protection Association (NFPA) that the source of stray voltages/currents is some sort of current naturally flowing in the earth are false and not supported by scientific fact.
3. Grounded electrodes required in the NEC for installation at the house and dock are imperfect, resistive connections to the earth. The resistance of these connections to earth are too large to reduce the voltages on grounded structures to safe levels.
4. Removing the "green" ground conductor between the house and dock service panels removes the risk of ESD due to elevated ground voltages. There must be a separate earthed ground electrode at the dock that is connected to equipment ground. Equipment ground must NOT be connected to the neutral conductor from the electrical supply. In addition, all circuit breakers at the dock service panel must be 4 to 6 mA, personal protection, GFCIs.
    a. Claims by NFPA members that the "green" ground conductor is required for GFCIs to operate are false.
    b. Claims by NFPA members that GFCIs will not trip if there is a fault to a grounded structure connected to an earthed electrode are false.
    c. Statements in the NEC that the earth can never be used as a return conductor are correct when applied to neutral returns, but are incorrect when applied to ground fault interrupt devices such as GFCIs.
5. Between the 2014 NEC and the 2017 NEC, the requirement for 4 to 6 mA personal protection GFCI breakers was replaced with 30 mA equipment protection GFPE breakers. As ESD is caused by currents above 10 mA, this is a very dangerous change. All breakers at residential docks must be 4 to 6 mA personal protection GFCI breakers.

Name: Frank C. Lambert Date: April 21, 2020

Signature: Frank C. Lambert

Qualifications (please attach a resume/publications list or provide degrees and/or experience below):

See Attached.

Additional Comments:

Franklin Cook Lambert, P.E.
Principal Research Engineer
National Electric Energy Testing, Research, and Applications Center
Center for Distributed Energy
School of Electrical and Computer Engineering
Georgia Institute of Technology

EDUCATIONAL BACKGROUND:

Degree	Year	University	Field
M.S.E.E.	1976	Georgia Institute of Technology	Power Systems
B.E.E.	1973	Georgia Institute of Technology	Power Systems

EMPLOYMENT HISTORY:

Title	Organization	Years
Principal Research Engineer	NEETRAC / Georgia Tech	14
Sr. Research Engineer	NEETRAC / Georgia Tech	11
Distribution Manager	Georgia Power Company	5
Manager, Network Underground	Georgia Power Company	2
Research Manager	Georgia Power Company	8
Network Test Supervisor	Georgia Power Company	2
Research Engineer	Georgia Power Company	1
Transmission Engineer	Georgia Power Company	1
Distribution Engineer	Georgia Power Company	3

CURRENT FIELDS OF INTEREST:

Power Delivery Equipment, Automation and Systems; Fault Current Limiters, Power Quality; Communications for Electric Utility Automation (WiMAX, Wireless Sensor Networks, Wireless Mesh Networks), Grid Connected Hybrid Vehicles,

QUALIFICATION STATEMENT:

Mr. Lambert is nationally recognized as an industry expert in electrical distribution and transmission systems. His 22 years of broad engineering and management experience with the Georgia Power Company have been integrated into a comprehensive research and development program in Electrical Systems at Georgia Tech for NEETRAC. Mr. Lambert serves as the Associate Director and Program Manager for Systems Analysis at NEETRAC. Over the last 23 years, he has directed 138 research projects with a total budget of over $15,000,000 focused on new developments and improvements in the electric power delivery infrastructure including the development of grid connected electric and hybrid vehicles. A number of these research projects have involved faculty

and graduate students from ECE Power and Telecommunications, MSE, ME, Chemistry, ISyE, and GTRI. His experience includes the design, construction and operation of the Georgia Power Company / Georgia Tech NEETRAC laboratory facilities.

Mr. Lambert is leading two new ARPA-E initiatives in collaboration with faculty from ECE and ME: development of Smart Wires technology to control power flows on the transmission network and development of a medium voltage test bed for power flow control technologies.

The technical contributions of Mr. Lambert are evidenced through his involvement in both local and national professional industry activities. He led the Atlanta Chapter of IEEE Power Engineering Society and was recognized as Chairman of the Outstanding Chapter in 1994. At the international level, he has served on a wide variety of industry standards committees and presently focuses his activities primarily through working groups of the IEEE PES Distribution Subcommittee addressing exposure voltages, Smart Distribution, reliability and power quality issues and the IEEE PES Switchgear Committee on High Voltage Fuses and Fault Current Limiters. He also served on CIGRE Working Group A3.23 to develop an Application Guide for Fault Current Limiters. Mr. Lambert was elected President Elect of IEEE PES in 2018 and is currently serving as PES President.

Mr. Lambert has also provided leadership to development of standards for electric and hybrid vehicle interconnection to the electric utility grid. He has served as Chair of the Society of Automotive Engineers (SAE) Committee J2293 which developed the charging interface protocols for electric vehicles and now chairs the working group on Plug-in hybrid and electric vehicles for the Infrastructure Working Council.

Mr. Lambert has also been active in service to Georgia Tech and the education community. He has served as Chair of the Welfare and Security Committee of the Faculty and chaired of the ad-hoc committee to develop a comprehensive implementation plan for Automatic External Defibrillators (AEDs) on campus. Mr. Lambert also served for 14 years as a Member of the Fulton County Board of Education.

I. RESEARCH AND CREATIVE SCHOLARSHIP

A. <u>Research Program Development</u>

Mr. Lambert is responsible for the Systems and Analysis Program for NEETRAC. This includes research work on power transmission and distribution equipment, automation, and systems; electrical insulation systems; power electronics; power quality; grounding; information and energy distribution integration; and electric & hybrid vehicles.

Two new major research program initiatives are currently underway:

1. An initial project was launched in 2009 with our NEETRAC members to develop and test Smart Wires technology for control of power flow on the transmission grid. ARPA-E funding was added in 2012 and the pilot implementation installed on a 161 kV transmission line in the TVA grid in October 2012.
2. In collaboration with Dr. Santiago Grijalva in ECE, a project was launched with ARPA-E in 2012 to develop a test bed at NEETRAC to evaluate the performance of new medium voltage power flow control technologies for the grid.

B. <u>Research Proposals and Contracts/Grants (PI)</u>

Mr. Lambert served as the PI for the following projects. As the PI, he was responsible for each project report, which range in length from 20 to over 400 pages. The Intellectual Property of those projects funded through NEETRAC is controlled by the NEETRAC Management Board and outside publication is restricted.

Title: Olympic Electric Tram System
Sponsor: NEETRAC
Co-P.I.(s): Dr. Richard Bass
Amount Requested: $49,900 Date Submitted: 2/27/96
Result: Awarded
Funded: $49,900 Period of Performance: 7 months

Title: PV System Performance
Sponsor: NEETRAC
Co-P.I.(s): Dr. Miroslav Begovic
Amount Requested: $36,200 Date Submitted: 2/27/96
Result: Awarded
Funded: $36,200 Period of Performance: 7 months

Title: Life Cycle Cost Analysis of the Distribution System
Sponsor: NEETRAC
Co-P.I.(s): Dr. Miroslav Begovic
Amount Requested: $48,700 Date Submitted: 2/27/96
Result: Awarded
Funded: $48,700 Period of Performance: 9 months

Title: Electric Vehicle – Hybrid Vehicle Simulation Model
Sponsor: NEETRAC / DARPA
Co-P.I.(s): Dr. Tom Habetler
Amount Requested: $200,000 Date Submitted: 2/27/96
Result: Awarded
Funded: $200,000 Period of Performance: 18 months

Title: Lightning Performance Based Grounding Design & Analysis of the Transmission System
Sponsor: NEETRAC
Co-P.I.(s): Dr. Sakis Meliopoulos, Shashi Patel
Amount Requested: $75,400 Date Submitted: 8/26/96
Result: Awarded
Funded: $75,400 Period of Performance: 18 months

Title: Application of Lightning Arresters on Transmission Lines
Sponsor: NEETRAC
Co-P.I.(s): Dr. Sakis Meliopoulos, Shashi Patel
Amount Requested: $57,800 Date Submitted: 8/26/96
Result: Awarded
Funded: $57,800 Period of Performance: 18 months

Title: Power Quality Impact of EV Charging on the Distribution System
Sponsor: Electric Power Research Institute
Co-P.I.(s): Dr. Richard M. Bass
Amount Requested: $50,000 Date Submitted: 11/6/96
Result: Awarded
Funded: $50,000 Period of Performance: 10 months

Title: Electric Transportation Program Support
Sponsor: Georgia Power Company
Amount Requested: $188,604 Date Submitted: 12/20/96
Result: Awarded
Funded: $188,604 Period of Performance: 12 months

Title: Electric Transit Vehicle Institute - 31 ft. Electric Bus Development
Sponsor: DARPA
Amount Requested: $20,000 Date Submitted: 1/30/97
Result: Awarded
Funded: $20,000 Period of Performance: 3 months

Title: Rapid Charging and Battery Management for Heavy Duty Electric Vehicles
Sponsor: DARPA
Co-P.I.(s): Dr. Caryn Riley
Amount Requested: $331,690 Date Submitted: 2/1/97
Result: Awarded
Funded: $331,690 Period of Performance: 24 months

Title: Transmission Reliability, Unknown or Unexplained Outages
Sponsor: NEETRAC
Amount Requested: $39,400 Date Submitted: 5/21/97
Result: Awarded

Funded: $39,400 Period of Performance: 9 months

Title: EV Data Collection Procedure Development
Sponsor: EPRI
Amount Requested: $9,050 Date Submitted: 5/25/97
Result: Awarded
Funded: $9,050 Period of Performance: 3 months

Title: Bus EV Charging Issues
Sponsor: EPRI
Co-P.I.(s): Dr. Richard Bass
Amount Requested: $16,980 Date Submitted: 7/23/97
Result: Awarded
Funded: $16,980 Period of Performance: 7 months

Title: Distribution System Equipment Reliability Centered Maintenance Program Model
Sponsor: NEETRAC
Co-P.I.(s): Dr. Anton Kleywegt (ISYE)
Amount Requested: $111,058 Date Submitted: 8/28/97
Result: Awarded
Funded: $111,058 Period of Performance: 12 months

Title: Life Cycling of the Distribution System - Phase II
Sponsor: NEETRAC
Co-P.I.(s): Dr. Miroslav Begovic
Amount Requested: $99,153 Date Submitted: 8/28/97
Result: Awarded
Funded: $99,153 Period of Performance: 12 months

Title: Distribution System Grounding & Power Quality Guidelines
Sponsor: NEETRAC
Co-P.I.(s): Dr. Sakis Meliopoulos
Amount Requested: $12,300 Date Submitted: 11/13/97
Result: Awarded
Funded: $12,300 Period of Performance: 6 months

Title: Accelerated Aging of ADSS Fiberoptic Cables
Sponsor: NEETRAC
Amount Requested: $147,793 Date Submitted: 11/13/97
Result: Awarded
Funded: $147,793 Period of Performance: 18 months

Title: Performance Evaluation of Distribution System MOV Lightning Arresters
Sponsor: NEETRAC

Co-P.I.(s): Ray Hill
Amount Requested: $318,150 Date Submitted: 11/13/97
Result: Awarded
Funded: $318,150 Period of Performance: 7 months

Title: Electric Transportation Program Support
Sponsor: Georgia Power Company
Amount Requested: $203,112 Date Submitted: 12/13/97
Result: Awarded
Funded: $203,112 Period of Performance: 12 months

Title: Feasibility Study for a Decision Support System for Distribution Equipment
Sponsor: Florida Power & Light
Co-P.I.(s): Dr. Anton Kleywegt (ISYE)
Amount Requested: $18,000 Date Submitted: 7/1/98
Result: Awarded
Funded: $18,000 Period of Performance: 6 months

Title: Distribution Transformer Loading
Sponsor: NEETRAC
Amount Requested: $67,478 Date Submitted: 8/26/98
Result: Awarded
Funded: $67,478 Period of Performance: 8 months

Title: Secondary Distribution Impacts of Residential EV Charging
Sponsor: Consortium of California Energy Commission, PG&E,
San Diego D&E, Southern California Edison, Virginia Power, Florida Power & Light, and Southern Company
Co-P.I.(s): Dr. Richard Bass
Amount Requested: $195,000 Date Submitted: 9/13/98
Result: Awarded
Funded: $195,000 Period of Performance: 15 months

Title: Study of the Effects of Electric Vehicles **(**EV's**)** On the Distribution System
Sponsor: Florida Power & Light
Co-P.I.(s): Dr. Richard Bass
Amount Requested: $23,000 Date Submitted: 9/15/98
Result: Awarded
Funded: $23,000 Period of Performance: 6 months

Title: Electric Transportation Program Support
Sponsor: Georgia Power Company
Amount Requested: $213,503 Date Submitted: 12/31/98
Result: Awarded

Funded: $100,000 Period of Performance: 12 months

Title: Transmission and Substation Personnel Safety Ground Testing and Evaluation
Sponsor: NEETRAC
Co-P.I.(s): Shashi Patel
Amount Requested: $80,240 Date Submitted: 1/13/99
Result: Awarded
Funded: $80,240 Period of Performance: 12 months

Title: Impact of Residential HVAC Scroll Compressors on the Distribution System
Sponsor: NEETRAC
Co-P.I.(s): Dr. Miroslav Begovic
Amount Requested: $61,400 Date Submitted: 1/13/99
Result: Awarded
Funded: $61,400 Period of Performance: 7 months

Title: Extension of the Hybrid Electric HMMWV Power Train Development Program – Application as a General Purpose Hybrid Truck Chassis and Introduction as a Utility Industry Trouble Truck and Mobile Power System
Sponsor: DARPA
Co-P.I.(s): Dr. Caryn Riley
Amount Requested: $129,553 Date Submitted: 3/1/99
Result: Awarded
Funded: $129,553 Period of Performance: 24 months

Title: Microstructural Changes Due To Cryogenic Treatment of Cu-W Electrical Contact Tips, Phase 1 – Initial Investigation
Sponsor: Alabama Power Company
Co-P.I.(s): Dr. Arun Gokhale (MSE)
Amount Requested: $15,648 Date Submitted: 3/12/99
Result: Awarded
Funded: $15,648 Period of Performance: 3 months

Title: Padmounted Transformer Evaluation
Sponsor: NEETRAC
Co-P.I.(s): Tom Champion
Amount Requested: $122,650 Date Submitted: 5/13/99
Result: Awarded
Funded: $122,650 Period of Performance: 10 months

Title: Interface Dielectric Test Evaluation of Loadbreak Separable Connectors
Sponsor: NEETRAC
Co-P.I.(s): Tom Champion

Amount Requested: $97,600 Date Submitted: 9/13/99
Result: Awarded
Funded: $97,600 Period of Performance: 11 months

Title: Predictive Maintenance Tests for Power Transformer Bushings
Sponsor: NEETRAC
Co-P.I.(s): Larry Coffeen
Amount Requested: $60,000 Date Submitted: 9/13/99
Result: Awarded
Funded: $60,000 Period of Performance: 12 months

Title: Distribution Transformer Loading – Follow-up Projects
Sponsor: Joint Direct Placed
Amount Requested: $37,050 Date Submitted: 1/5/00
Result: Awarded
Funded: $37,050 Period of Performance: 6 months

Title: IWC Bus/Non-Road Committee Representation
Sponsor: Georgia Power Company
Amount Requested: $35,801 Date Submitted: 2/02/00
Result: Awarded
Funded: $35,801 Period of Performance: 11 months

Title: Power Quality Impacts of Airport GSE Charging Systems
Sponsor: EPRI & California Energy Commission
Co-P.I.(s): Dr. Ron Harley
Amount Requested: $188,000 Date Submitted: 2/21/00
Result: Pending
Funded: Period of Performance: 12 months

Title: Stray Voltages – Concerns, Analysis, and Mitigation
Sponsor: NEETRAC
Co-P.I.(s): Shashi Patel
Amount Requested: $72,000 Date Submitted: 4/05/00
Result: Awarded
Funded: $72,000 Period of Performance: 12 months

Title: Impact of Residential HVAC Compressors on the Distribution System
Sponsor: NEETRAC
Co-P.I.(s): Miroslav Begovic
Amount Requested: $65,260 Date Submitted: 7/23/00
Result: Awarded
Funded: $65,260 Period of Performance: 10 months

Title: Field Evaluation of Distribution System MOV Lightning Arresters –Phase 1
Sponsor: NEETRAC
Co-P.I.(s): Tom Champion
Amount Requested: $25,000 Date Submitted: 8/04/00
Result: Awarded
Funded: $25,000 Period of Performance: 6 months

Title: Distribution Transformer Loading – Cooper FR3
Sponsor: Joint Direct Placed
Amount Requested: $8,600 Date Submitted: 11/1/00
Result: Awarded
Funded: $8,600 Period of Performance: 5 months

Title: IWC Bus/Non-Road Committee Representation
Sponsor: Georgia Power Company
Amount Requested: $35,644 Date Submitted: 12/02/00
Result: Awarded
Funded: $35,644 Period of Performance: 12 months

Title: Characterization of Polypropylene
Sponsor: Cooper
Co-P.I.(s): Jon Crate, GTRI
Amount Requested: $15,675 Date Submitted: 12/04/00
Result: Awarded
Funded: $15,675 Period of Performance: 8 months

Title: Interface Dielectric Test Evaluation of Loadbreak Separable Connectors – Phase 2
Sponsor: NEETRAC
Co-P.I.(s): Tom Champion
Amount Requested: $84,000 Date Submitted: 1/23/01
Result: Awarded
Funded: $84,000 Period of Performance: 12 months

Title: Partial Discharge Detection within On-line Power System Equipment
Sponsor: NEETRAC
Co-P.I.(s): Larry Coffeen
Amount Requested: $105,000 Date Submitted: 1/23/01
Result: Awarded
Funded: $105,000 Period of Performance: 18 months

Title: Transmission and Substation Personnel Safety Ground Testing and Evaluation - Phase 2
Sponsor: NEETRAC

Co-P.I.(s): Shashi Patel
Amount Requested: $67,000 Date Submitted: 1/23/01
Result: Awarded
Funded: $67,000 Period of Performance: 12 months

Title: Distribution Feeder Volt / Var Optimization Strategies
Sponsor: NEETRAC
Co-P.I.(s): Dr. Miroslav Begovic
Amount Requested: $94,200 Date Submitted: 1/23/01
Result: Awarded
Funded: $94,200 Period of Performance: 10 months

Title: Distribution Feeder Protection Strategies
Sponsor: NEETRAC
Co-P.I.(s): Miroslav Begovic
Amount Requested: $75,200 Date Submitted: 1/23/01
Result: Awarded
Funded: $75,200 Period of Performance: 10 months

Title: Distribution System Field HIVARC Leakage Current Test Set Development and Field Testing
Sponsor: NEETRAC
Co-P.I.(s): Jeff Hildreth
Amount Requested: $134,850 Date Submitted: 1/23/01
Result: Awarded
Funded: $99,500 Period of Performance: 15 months

Title: Service Entrance Surge Protective Device - “End-of-Life Failure Mode” New Evaluation Methodology
Sponsor: NEETRAC
Co-P.I.(s): Ray Hill
Amount Requested: $69,200 Date Submitted: 1/23/01
Result: Awarded
Funded: $69,200 Period of Performance: 8 months

Title: Grid Connected Fuel Cell System for Distributed Power Generation
Sponsor: Allied Utility Systems
Co-P.I.(s): Drs. Caryn Riley, Thom Orlando (Chem), Sam Shelton (ME)
Amount Requested: $100,000 Date Submitted: 02/15/01
Result: Awarded
Funded: $100,000 Period of Performance: 12 months

Title: Power Quality Impacts of Airport GSE Charging Systems
Sponsor: EPRI & California Energy Commission
Co-P.I.(s): Dr. Ron Harley

Amount Requested: $188,000 Date Submitted: 2/21/01
Result: Awarded
Funded: $165,000 Period of Performance: 14 months

Title: Evaluation of OH & UG Faulted Circuit Indicators
Sponsor: NEETRAC
Co-P.I.(s): Thomas Parker
Amount Requested: $52,000 Date Submitted: 5/9/01
Result: Awarded
Funded: $52,000 Period of Performance: 8 months

Title: Dielectric Performance of Wildlife Guards and Deterrents
Sponsor: NEETRAC
Co-P.I.(s): Tom Champion, Caryn Riley
Amount Requested: $113,000 Date Submitted: 5/9/01
Result: Awarded
Funded: $113,000 Period of Performance: 15 months

Title: Arrester Energy Handling Capability
Sponsor: NEETRAC
Co-P.I.(s): Ray Hill
Amount Requested: $58,500 Date Submitted: 5/9/01
Result: Awarded
Funded: $58,500 Period of Performance: 10 months

Title: Padmounted Transformer Evaluation - Phase 2
Sponsor: NEETRAC
Co-P.I.(s): Tom Champion
Amount Requested: $144,300 Date Submitted: 5/9/01
Result: Awarded
Funded: $144,300 Period of Performance: 12 months

Title: Powerline Carrier Evaluation
Sponsor: Schlumberger
Co-P.I.(s): Eric Barnhart, GTRI
Amount Requested: $50,000 Date Submitted: 8/26/01
Result: Awarded
Funded: $50,000 Period of Performance: 12 months

Title: Field Evaluation of Distribution MOV Arresters - Phase 2
Sponsor: NEETRAC
Co-P.I.(s): Ray Hill
Amount Requested: $222,100 Date Submitted: 9/25/01
Result: Awarded

Funded: $222,100 Period of Performance: 18 months

Title: PWM Tap Changing Voltage Regulator
Sponsor: Southern States, Inc
Co-P.I.(s): Drs. Ron Harley & Tom Habetler
Amount Requested: $12,300 Date Submitted: 9/01/01
Result: Awarded
Funded: $12,300 Period of Performance: 4 months

Title: PWM Tap Changing Voltage Regulator – Phase 2
Sponsor: Southern States, Inc
Co-P.I.(s): Drs. Ron Harley & Tom Habetler
Amount Requested: $264,052 Date Submitted: 11/21/01
Result: Awarded
Funded: $264,052 Period of Performance: 24 months

Title: IWC Bus/Non-Road Committee Representation
Sponsor: Georgia Power Company
Amount Requested: $31,560 Date Submitted: 01/08/02
Result: Awarded
Funded: $31,560 Period of Performance: 12 months

Title: Evaluation of Neutral Isolation Devices
Sponsor: NEETRAC
Co-P.I.(s): Shashi Patel
Amount Requested: $98,400 Date Submitted: 1/15/02
Result: Awarded
Funded: $98,400 Period of Performance: 15 months

Title: Optimization of Reactive Resources
Sponsor: NEETRAC
Co-P.I.(s): Miroslav Begovic
Amount Requested: $143,800 Date Submitted: 1/15/02
Result: Awarded
Funded: $143,800 Period of Performance: 18 months

Title: Secondary Cable Fault Location Techniques
Sponsor: NEETRAC
Co-P.I.(s): Caryn Riley
Amount Requested: $85,000 Date Submitted: 5/08/02
Result: Awarded
Funded: $85,000 Period of Performance: 12 months

Title: BIL Characteristics of OH Distribution Pole Configurations
Sponsor: NEETRAC
Co-P.I.(s): Caryn Riley
Amount Requested: $98,000 Date Submitted: 5/08/02
Result: Awarded
Funded: $98,000 Period of Performance: 15 months

Title: Fault Duty Capability of UD Separable Connectors
Sponsor: NEETRAC
Co-P.I.(s): Tom Champion
Amount Requested: $79,000 Date Submitted: 5/08/02
Result: Awarded
Funded: $79,000 Period of Performance: 15 months

Title: Protection of Instrumentation, Control, and Data Circuits in Substations
Sponsor: NEETRAC
Co-P.I.(s): Shashi Patel
Amount Requested: $85,000 Date Submitted: 5/08/02
Result: Awarded
Funded: $85,000 Period of Performance: 12 months

Title: Evaluation of Power Transformer Extender Technology
Sponsor: NEETRAC
Amount Requested: $150,000 Date Submitted: 5/08/02
Result: Awarded
Funded: $150,000 Period of Performance: 15 months

Title: Transmission and Substation Personnel Safety Ground Testing and Evaluation - Phase 3
Sponsor: NEETRAC
Co-P.I.(s): Shashi Patel
Amount Requested: $21,000 Date Submitted: 9/01/02
Result: Awarded
Funded: $21,000 Period of Performance: 12 months

Title: Field P/F Test for MOV Lightning Arresters
Sponsor: NEETRAC
Co-P.I.(s): Larry Coffeen
Amount Requested: $195,700 Date Submitted: 9/25/02
Result: Awarded
Funded: $195,700 Period of Performance: 18 months

Title: End of Life Failure Mode Investigation for Electronic Watthour Meters
Sponsor: NEETRAC
Co-P.I.(s): Ray Hill
Amount Requested: $71,000 Date Submitted: 9/25/02

Result: Awarded
Funded: $71,000 Period of Performance: 12 months

Title: Superconducting Fault Current Limiter
Sponsor: IGC SuperPower
Amount Requested: $39,100 Date Submitted: 11/01/02
Result: Awarded
Funded: $39,100 Period of Performance: 6 months

Title: Accelerated Aging Test for Vacuum Interrupters
Sponsor: NEETRAC
Co-P.I.(s): Tom Champion
Amount Requested: $98,000 Date Submitted: 1/15/03
Result: Awarded
Funded: $98,000 Period of Performance: 18 months

Title: Arrester Energy Handling Capability – Phase 2
Sponsor: NEETRAC
Co-P.I.(s): Ray Hill
Amount Requested: $68,500 Date Submitted: 1/15/03
Result: Awarded
Funded: $68,500 Period of Performance: 12 months

Title: IWC Bus/Non-Road Committee Representation
Sponsor: Georgia Power Company
Amount Requested: $33,424 Date Submitted: 04/01/03
Result: Awarded
Funded: $33,424 Period of Performance: 12 months

Title: Superhydrophobic Surface Coatings for Electrical Insulators
Sponsor: NEETRAC
Co-P.I.(s): Dr. C. P. Wong (MSE)
Amount Requested: $98,500 Date Submitted: 5/08/03
Result: Awarded
Funded: $98,500 Period of Performance: 15 months

Title: OH Line Surge Arrester Separation Distance
Sponsor: NEETRAC
Co-P.I.(s): Ray Hill
Amount Requested: $95,000 Date Submitted: 9/24/03
Result: Awarded
Funded: $95,000 Period of Performance: 15 months

Title: Separable Connector Field Problem Investigations
Sponsor: NEETRAC
Co-P.I.(s): Tom Champion

Amount Requested: $148,000 Date Submitted: 9/24/03
Result: Awarded
Funded: $148,000 Period of Performance: 18 months

Title: Stray Voltage Seminars
Sponsor: NRECA
Amount Requested: $12,915 Date Submitted: 12/19/03
Result: Awarded
Funded: $12,915 Period of Performance: 12 months

Title: Distributed Generation Screening Tool
Sponsor: Georgia Power Company
Co-P.I.(s): Dr. Miroslav Begovic
Amount Requested: $25,910 Date Submitted: 1/02/04
Result: Awarded
Funded: $25,910 Period of Performance: 12 months

Title: Commercialization of Field P/F Test Set for MOV Arresters
Sponsor: NEETRAC
Co-P.I.(s): Larry Coffeen
Amount Requested: $78,000 Date Submitted: 1/15/04
Result: Awarded
Funded: $78,000 Period of Performance: 12 months

Title: Padmounted Transformer Tank Temperatures
Sponsor: NEETRAC
Co-P.I.(s): Tim Andrews
Amount Requested: $97,900 Date Submitted: 1/15/04
Result: Awarded
Funded: $97,900 Period of Performance: 18 months

Title: Evaluation of OH Faulted Circuit Indicators
Sponsor: NEETRAC
Co-P.I.(s): Tom Parker
Amount Requested: $95,300 Date Submitted: 1/15/04
Result: Awarded
Funded: $95,300 Period of Performance: 18 months

Title: Superconducting Fault Current Limiter Development Program
Sponsor: NEETRAC
Amount Requested: $15,000 Date Submitted: 03/01/04
Result: Awarded

Funded: $15,000 Period of Performance: 9 months

Title: Contact Corrosion Investigation
Sponsor: Cooper Power Systems
Co-P.I.(s): Dr. Lisa Detter-Hoskins, GTRI
Amount Requested: $15,300 Date Submitted: 03/224
Result: Awarded
Funded: $15,300 Period of Performance: 6 months

Title: OH Loadbreak Switch Interrupters – Scoping Study
Sponsor: NEETRAC
Co-P.I.(s): Tom Champion
Amount Requested: $23,000 Date Submitted: 5/12/04
Result: Awarded
Funded: $23,000 Period of Performance: 6 months

Title: Optimization of Reactive Resources in T&D Networks – Phase 2
Sponsor: NEETRAC
Co-P.I.(s): Miroslav Begovic
Amount Requested: $145,000 Date Submitted: 5/12/04
Result: Awarded
Funded: $145,000 Period of Performance: 18 months

Title: Stray Voltage Concerns, Analysis, and Mitigation – Phase 2
Sponsor: NEETRAC
Co-P.I.(s): Shashi Patel
Amount Requested: $95,000 Date Submitted: 5/12/04
Result: Awarded
Funded: $95,000 Period of Performance: 18 months

Title: Standards & Methods for Dielectric Performance of Wildlife Guards & Deterrents – Phase 2
Sponsor: NEETRAC
Co-P.I.(s): Caryn Riley
Amount Requested: $120,000 Date Submitted: 5/12/04
Result: Awarded
Funded: $120,000 Period of Performance: 18 months

Title: Methods to Evaluate Lightning Performance of Substations – Scoping Study
Sponsor: NEETRAC
Co-P.I.(s): Shashi Patel
Amount Requested: $29,000 Date Submitted: 5/12/04
Result: Awarded
Funded: $29,000 Period of Performance: 6 months

Title: Communications Infrastructure for Electric System Automation
Sponsor: NEETRAC
Co-P.I.(s): Dr. Ian Akyildiz
Amount Requested: $141,300 Date Submitted: 5/12/04
Result: Awarded
Funded: $141,300 Period of Performance: 15 months

Title: EPRI IWC Committee Representation
Sponsor: Georgia Power Company
Amount Requested: $40,000 Date Submitted: 06/01/04
Result: Awarded
Funded: $40,000 Period of Performance: 12 months

Title: Harmonic Metering
Sponsor: NEETRAC
Co-P.I.(s): Dr. Ron Harley
Amount Requested: $24,500 Date Submitted: 8/01/04
Result: Awarded
Funded: $24,500 Period of Performance: 9 months

Title: Superhydrophobic Surface Coatings – Phase 2
Sponsor: NEETRAC
Co-P.I.(s): Dr. C. P. Wong (MSE)
Amount Requested: $150,000 Date Submitted: 9/16/04
Result: Awarded
Funded: $150,000 Period of Performance: 18 months

Title: Neutral Grounding Resistor Evaluation
Sponsor: PSE&G
Amount Requested: $23,600 Date Submitted: 10/25/04
Result: Awarded
Funded: $23,600 Period of Performance: 6 months

Title: Distribution Asset Management – Scoping Study
Sponsor: NEETRAC
Amount Requested: $38,200 Date Submitted: 2/02/05
Result: Awarded
Funded: $38,200 Period of Performance: 9 months

Title: Potential Application of Sensor Networks in Power Delivery
Co-P.I.(s): Dr. Deepak Divan
Sponsor: NEETRAC
Amount Requested: $51,500 Date Submitted: 2/02/05
Result: Awarded
Funded: $51,500 Period of Performance: 12 months

Title: Evaluation of Field Test Methods for SiC Arresters – Scoping Study
Co-P.I.(s): Larry Coffeen
Sponsor: NEETRAC
Amount Requested: $29,000 Date Submitted: 5/05/05
Result: Awarded
Funded: $29,000 Period of Performance: 8 months

Title: Evaluation of Direct Neutral vs. Pole Band Grounding
Co-P.I.(s): Shashi Patel
Sponsor: NEETRAC
Amount Requested: $79,000 Date Submitted: 5/05/05
Result: Awarded
Funded: $79,000 Period of Performance: 12 months

Title: Polymer Cutout Evaluation
Co-P.I.(s): Tom Champion
Sponsor: NEETRAC
Amount Requested: $248,000 Date Submitted: 5/05/05
Result: Awarded
Funded: $248,000 Period of Performance: 18 months

Title: OH Loadbreak Switch Interrupters
Co-P.I.(s): Tom Champion
Sponsor: NEETRAC
Amount Requested: $235,000 Date Submitted: 5/05/05
Result: Awarded
Funded: $235,000 Period of Performance: 18 months

Title: Dist. Ground Fault Impedance - Scoping Study
Co-P.I.(s): Shashi Patel
Sponsor: NEETRAC
Amount Requested: $33,500 Date Submitted: 9/25/05
Result: Awarded
Funded: $33,500 Period of Performance: 12 months

Title: Dist. Sensors for Dielectric Fluids - Scoping Study
Co-P.I.(s): Tom Champion
Sponsor: NEETRAC
Amount Requested: $39,800 Date Submitted: 9/25/05
Result: Awarded
Funded: $39,800 Period of Performance: 12 months

Title: Dist. Communications Infrastructure - Automation Phase 2
Co-P.I.(s): Dr. Ian Akyildiz
Sponsor: NEETRAC
Amount Requested: $135,000 Date Submitted: 9/25/05

Result: Awarded
Funded: $135,000 Period of Performance: 15 months

Title: Dist. Line Switch / OCB Arrester Separation Model Validation
Co-P.I.(s): Ray Hill
Sponsor: NEETRAC
Amount Requested: $79,500 Date Submitted: 9/25/05
Result: Awarded
Funded: $79,500 Period of Performance: 12 months

Title: Dist. Arc/Flash Hazards - T&D - Scoping Study
Sponsor: NEETRAC
Amount Requested: $38,500 Date Submitted: 1/25/06
Result: Awarded
Funded: $38,500 Period of Performance: 12 months

Title: Dist. Surge Arrester Disconnect Device Reliability
Co-P.I.(s): Ray Hill
Sponsor: NEETRAC
Amount Requested: $148,000 Date Submitted: 5/25/06
Result: Awarded
Funded: $148,000 Period of Performance: 15 months

Title: Stands. & Meths. for Eval. Dielec. Perf. Wildlife - Phase III
Co-P.I.(s): Caryn Riley
Sponsor: NEETRAC
Amount Requested: $225,000 Date Submitted: 5/25/06
Result: Awarded
Funded: $225,000 Period of Performance: 24 months

Title: Superhydrophobic Surface Coating - Phase III
Co-P.I.(s): Dr. C. P. Wong
Sponsor: NEETRAC
Amount Requested: $369,000 Date Submitted: 5/25/06
Result: Awarded
Funded: $369,000 Period of Performance: 36 months

Title: Ground Impedance Measuring Devices
Co-P.I.(s): Ray Hill
Sponsor: NEETRAC
Amount Requested: $119,000 Date Submitted: 9/25/06
Result: Awarded
Funded: $119,000 Period of Performance: 12 months

Title: Neutral to Earth Jacket Impulse Characteristics of Jackets
Co-P.I.(s): Dr. Sakis Meliopoulos

Sponsor: NEETRAC
Amount Requested: $115,000 Date Submitted: 9/25/06
Result: Awarded
Funded: $115,000 Period of Performance: 24 months

Title: Capacitor Bank Fuse Operation - Scoping Study
Sponsor: NEETRAC
Amount Requested: $35,000 Date Submitted: 1/25/07
Result: Awarded
Funded: $35,000 Period of Performance: 12 months

Title: Field Device Information Management & Integration - Scoping Study
Sponsor: NEETRAC
Amount Requested: $39,000 Date Submitted: 1/25/07
Result: Awarded
Funded: $39,000 Period of Performance: 12 months

Title: Fault Current Limiter & Power Flow Controller - Phase 1
Co-P.I.(s): Dr. Deepak Divan
Sponsor: NEETRAC
Amount Requested: $85,000 Date Submitted: 1/25/07
Result: Awarded
Funded: $85,000 Period of Performance: 15 months

Title: Optical Interferometric Sensor for DGA - Proof of Concept
Co-P.I.(s): Dan Campbell
Sponsor: NEETRAC
Amount Requested: $213,000 Date Submitted: 1/25/07
Result: Awarded
Funded: $213,000 Period of Performance: 24 months

Title: Feeder Voltage Phenomena - Phase I: Characterization
Co-P.I.(s): Dr. Sakis Meliopoulos
Sponsor: NEETRAC
Amount Requested: $89,000 Date Submitted: 1/25/07
Result: Awarded
Funded: $89,000 Period of Performance: 15 months

Title: Energy Harvesting for WSNs - Scoping Study
Co-P.I.(s): Dr. Deepak Divan
Sponsor: NEETRAC
Amount Requested: $60,000 Date Submitted: 5/25/07
Result: Awarded
Funded: $60,000 Period of Performance: 12 months

Title: Appl. and Perf. of TPG Systems - Handbook
Co-P.I.(s): Shashi Patel
Sponsor: NEETRAC
Amount Requested: $125,000 Date Submitted: 5/25/07
Result: Awarded
Funded: $125,000 Period of Performance: 18 months

Title: Distribution Insulator Performance Evaluation
Co-P.I.(s): Caryn Riley
Sponsor: NEETRAC
Amount Requested: $145,000 Date Submitted: 5/25/07
Result: Awarded
Funded: $145,000 Period of Performance: 18 months

Title: Overhead Cutout Failure Analysis - Porcelain Focus
Co-P.I.(s): Tom Champion
Sponsor: NEETRAC
Amount Requested: $150,000 Date Submitted: 5/25/07
Result: Awarded
Funded: $150,000 Period of Performance: 24 months

Title: AMI Applications for Power Delivery - Scoping Study
Sponsor: NEETRAC
Amount Requested: $39,000 Date Submitted: 9/21/07
Result: Awarded
Funded: $39,000 Period of Performance: 12 months

Title: Integral Disconnect Switches for Single Phase Meters
Co-P.I.(s): Ray Hill
Sponsor: NEETRAC
Amount Requested: $197,000 Date Submitted: 9/25/07
Result: Awarded
Funded: $197,000 Period of Performance: 24 months

Title: Next Generation PMUs / Evaluation
Co-P.I.(s): Dr. Sakis Meliopoulos
Sponsor: NEETRAC
Amount Requested: $169,000 Date Submitted: 1/21/08
Result: Awarded
Funded: $169,000 Period of Performance: 18 months

Title: 27 kV Polymer Cutout Evaluation
Co-P.I.(s): Caryn Riley
Sponsor: NEETRAC
Amount Requested: $420,000 Date Submitted: 5/21/08

Result: Awarded
Funded: $420,000 Period of Performance: 24 months

Title: Distribution Insulator Evaluation - Polymer Suspension
Co-P.I.(s): Caryn Riley
Sponsor: NEETRAC
Amount Requested: $210,000 Date Submitted: 5/21/08
Result: Awarded
Funded: $210,000 Period of Performance: 24 months

Title: Impact of New Load Types on T&D Systems
Co-P.I.(s): Dr. Deepak Divan
Sponsor: NEETRAC
Amount Requested: $129,000 Date Submitted: 5/21/08
Result: Awarded
Funded: $129,000 Period of Performance: 18 months

Title: Distribution Insulator Evaluation - Post Type
Co-P.I.(s): Caryn Riley
Sponsor: NEETRAC
Amount Requested: $240,000 Date Submitted: 5/21/08
Result: Awarded
Funded: $240,000 Period of Performance: 24 months

Title: Stick-on Current / Temperature Wireless Sensor
Co-P.I.(s): Dr. Deepak Divan
Sponsor: NEETRAC
Amount Requested: $99,000 Date Submitted: 9/21/08
Result: Awarded
Funded: $99,000 Period of Performance: 12 months

Title: Eval. of Direct Neutral vs. Pole Band Grounding -Phase 2
Co-P.I.(s): Shashi Patel
Sponsor: NEETRAC
Amount Requested: $129,000 Date Submitted: 9/21/08
Result: Awarded
Funded: $129,000 Period of Performance: 18 months

Title: Feeder Voltage Phenomena - Phase 2 - Mitigation
Co-P.I.(s): Dr. Sakis Meliopoulos
Sponsor: NEETRAC
Amount Requested: $156,000 Date Submitted: 1/28/09
Result: Awarded
Funded: $156,000 Period of Performance: 24 months

Title: Energy Storage in the Future Grid
Co-P.I.(s): Dr. Deepak Divan
Sponsor: NEETRAC
Amount Requested: $129,000 Date Submitted: 5/12/09
Result: Awarded
Funded: $129,000 Period of Performance: 18 months

Title: Capacitor Tank Rupture - Test Protocol Standardization
Co-P.I.(s): Carson Day
Sponsor: NEETRAC
Amount Requested: $93,000 Date Submitted: 5/12/09
Result: Awarded
Funded: $93,000 Period of Performance: 24 months

Title: Nuisance Fuse Operations - Phase I
Co-P.I.(s): Tom Champion
Sponsor: NEETRAC
Amount Requested: $117,000 Date Submitted: 5/12/09
Result: Awarded
Funded: $117,000 Period of Performance: 18 months

Title: On-line Condition Assessment of Aging CCVTs & Carrier Traps
Co-P.I.(s): Larry Coffeen
Sponsor: NEETRAC
Amount Requested: $242,000 Date Submitted: 9/25/09
Result: Awarded
Funded: $242,000 Period of Performance: 24 months

Title: Directional Hybrid Active Harmonic Filter
Co-P.I.(s): Dr. Deepak Divan
Sponsor: NEETRAC
Amount Requested: $190,000 Date Submitted: 9/25/10
Result: Awarded
Funded: $190,000 Period of Performance: 24 months

Title: Stick-on Wireless Sensor – Phase 2
Co-P.I.(s): Dr. Deepak Divan
Sponsor: NEETRAC
Amount Requested: $164,000 Date Submitted: 9/25/10
Result: Awarded
Funded: $164,000 Period of Performance: 24 months

Title: Conservation Voltage Reduction - Performance Assessment
Co-P.I.(s): Drs. Miroslav Begovic and Yamille del Valle

Sponsor: NEETRAC
Amount Requested: $185,000 Date Submitted: 1/28/11
Result: Awarded
Funded: $185,000 Period of Performance: 24 months

Title: Compact Dynamic Phase Angle Regulator for Transmission Power Routing
Co-P.I.(s): Drs. Santiago Grijalva and Rhett Major
Sponsor: ARPA-E
Amount Requested: $ 1,178,918 Date Submitted: 7/18/11
Result: Awarded
Funded: $1,178,918 Period of Performance: 36 months

Title: Distributed Power Flow Control using Smart Wires for Energy Routing
Sponsor: ARPA-E
Amount Requested: $ 486,323 Date Submitted: 11/21/11
Result: Awarded
Funded: $486,323 Period of Performance: 24 months

Title: Known Problems w/Porcelain Ins. for T&D - Scoping Study
Co-P.I.(s): Tom Champion
Sponsor: NEETRAC
Amount Requested: $53,000 Date Submitted: 5/23/12
Result: Awarded
Funded: $53,000 Period of Performance: 12 months

Title: Review of Non-Wood Pole Technologies
Co-P.I.(s): Tom Champion
Sponsor: NEETRAC
Amount Requested: $62,000 Date Submitted: 9/25/12
Result: Awarded
Funded: $62,000 Period of Performance: 12 months

Contracts Funded (P.I.)	$1,914,154
Contracts Funded (Co-P.I.)	$13,713,037
Total	$15,627,191

B. Published Journal Papers (refereed)

1. H. B. Püttgen, F. C. Lambert, and R. P. Webb, "High Voltage Techniques Course: A Cooperative Effort between Georgia Tech and Georgia Power", *IEEE Trans. on Power Systems*, vol. 2, no. 3, pp. 574-580, May 1988. Lambert was the Georgia Power representative who organized the laboratory component of the course.
2. A. H. Bingham, F. C. Lambert, M. R. Monashkin, C. B. DeLuca, and T. B.

Shaw, "An Accelerated Performance Test of Electrical Connectors", *IEEE Trans. on Power Delivery*, vol. 3, no. 2, pp. 762-768, April 1988. Lambert was the Georgia Power representative who chaired the Working Group on Accelerated Connector Testing for ANSI C119.4 and authored the paper for the committee.

3. Bass, R.M.; Handran, D.; Lambert, F.C.; Kennedy, J.R., "Olympic Electric Tram System: Power Quality and Power Electronics", *Power Electronics in Transportation*, 1996. IEEE , Page(s): 207 – 214. Lambert was project manager for the tram system and coordinated the data collection and analysis portion of the work.
4. Handran, D.; Bass, R.; Lambert, F.; Kennedy, J. , "Simulation of Distribution Feeders And Charger Installation For The Olympic Electric Tram System", *Computers in Power Electronics*, 1996, IEEE Workshop on, Page(s):168–175. Lambert was project manager for the tram system and coordinated the data collection and analysis portion of the work.
5. J. Mazumdar, R. Harley, F. Lambert and G.K. Venayagamoorthy, "A Novel Method for Predicting Harmonic Current Injection from Non-Linear Loads using Neural Networks," *IEEE Transactions on Industrial Electronics*, IECON 2005. 31st Annual Conference of IEEE, Nov. 2005. Lambert was co-inventor for IP and project manager.
6. J. Mazumdar, R. Harley, F. Lambert and G.K. Venayagamoorthy, "Intelligent Tool for Determining the True Harmonic Current Contribution of a Customer in a Power Distribution Network," *IEEE Transactions on Industry Applications,* Sept.-Oct. 2008, Page(s):1477 – 1485. Lambert was co-inventor for IP and project manager.
7. V. Cagri and F. Lambert, "A Survey on Communication Networks for Electric System Automation", *Computer Networks, Elsevier.* February 2006. Lambert was project manager.
8. R. Moghe, F. C. Lambert and D. Divan, "Novel Low Cost Smart Current Sensor for Utility Assets", *IEEE Transactions on Smart Grid*, Vol. 3, Issue 2, 2012. Lambert was co-inventor for IP and project manager.

B. <u>Published Papers (non-refereed)</u>

1. Püttgen, H. B., MacGregor, P.R., Lambert, F. C., "Distributed Generation: Semantic hype or the Dawn of a New Era?", *IEEE Power & Energy Magazine*, Volume 1, Issue 1, January – February 2003, pp. 22-29.

C. <u>Invited Conference Presentations</u>

1. Lambert, F. C., "Acoustic Emission Testing of Insulated Aerial Personnel Devices", *The Doble Conference*, Boston, Massachusetts, April 1984.
2. Lambert, F. C., "Professional Competence - How Continuing Education Can Help Us from Losing It", Panel Session at the *Summer Power Meeting of the Power Engineering Society*, Long Beach, California, July 12, 1989.

3. Lambert, F. C., "Electric Vehicle Recharging Infrastructure", "Clean Air Vehicle Conference", Atlanta, Georgia, April 11, 1995.
4. Lambert, F. C., "Designing Buildings to Accommodate Electric Vehicles", *Electric 95 Conference*, Atlanta, Georgia, June 8, 1995.
5. Lambert, F.C., "Distribution Automation: A Survey of Recent Advances", Panel Session at the *Summer Power Meeting of the Power Engineering Society*, Portland, Oregon, July 26, 1995.
6. Lambert, F. C., "Electric Transportation System for the Olympic Village", *DARPA Conference on Hybrid & Electric Vehicles*, Seven Springs, Pennsylvania, November 20, 1996.
7. Lambert, F. C., "Battery Management System Issues", *DARPA Conference on Hybrid & Electric Vehicles*, Honolulu, Hawaii, April 29, 1997.
8. Lambert, F. C., "Electric & Hybrid Vehicle Technology", *EPRI Electric Bus Users Group Workshop*, Dallas, Texas, June 20, 1997.
9. Lambert, F. C., "Rapid Charging and Battery Management for Heavy Duty Electric Vehicles", *Advanced Lead-Acid Battery Consortium Conference*, London, England, March 26, 1998.
10. Lambert, F.C., "Transmission and Substation Personnel Safety Ground Testing and Evaluation", *2000 IEEE 9th International Conference on Transmission & Distribution Construction, Operation, & Live-Line Maintenance*, October 11, 2000, Montreal, Quebec.
11. Patel, S. G. and Lambert, F. C., "Transmission and Substation Personnel Safety Ground Testing and Evaluation", *IEEE 2001 Winter Power Meeting, Joint Meeting of TPC (Tower, Poles, and Conductors) and ESMOL (Engineering, Safety, Maintenance, Operation of Lines)*, January 31st, 2001, Columbus, Ohio.
12. Lambert, F.C., "Trial-Use Guide for Testing the Electrical, Mechanical, and Durability Performance of Wildlife Guards and Deterrents Used on Overhead Power Distribution Systems", *IEEE Distribution Subcommittee*, June 7, 2004, Denver, Colorado.
13. Lambert, F.C., "Thermal And Temperature Cycling Tests on Solid Dielectric Switches, Interrupters, And Reclosers", *IEEE Switchgear Committee*, September 21, 2004, Tucson, Arizona.
14. Lambert, F.C., "End of Life Testing of Internal MOVs in Self Contained Electric Meters", *ANSI C12 Committee on Electricity Meters*, October 13, 2004, Minneapolis, Minnesota.
15. Lambert, F.C., "Standards for V2G Interconnection to the Grid", *Vehicle to Grid (V2G) Technical Symposium*, June 6, 2005, Seattle, Washington.
16. Lambert, F.C., "Swimming Pool Equi-potential Bonding", Working Group on Stray and Contact Voltages, *IEEE PES General Meeting*, Pittsburgh, PA, July 2008.
17. Lambert, F.C., "Polymer Cutout Evaluation", *IEEE Switchgear Committee*, October 2008, Calgary, Alberta.
18. Lambert, F.C., "Accelerated Weathering Testing of Loadbreak Switch Interrupters", *IEEE Switchgear Committee*, October, 2008, Calgary, Alberta.

19. Lambert, F. C. and Patel, S., "Exposure Voltages on Distribution Systems", NRECA Tech Advantage, Atlanta, GA, February 2009.
20. Lambert, F.C., "27 kV Polymer Cutout Evaluation", *IEEE Switchgear Committee*, May 2009, Asheville, NC.
21. Lambert, F. C., "Integral Disconnect Switches for Single-Phase Revenue Meters", *ANSI C12.1*, October 2010.
22. Lambert, F.C., "Electric Vehicle Deployment and Infrastructure Implications in the United States", *World Energy Council – Switzerland Chapter*, EPFL, Lausanne, Switzerland, March 2012.
23. Lambert, F. C., "Polymer Cutout Testing Recommendations", *IEEE Switchgear Committee*, May 2012, St. Petersburg, FL.

D. Conference Presentations with Proceedings (refereed)

1. Lambert, F. C. "The Managerial Issues Affecting Distribution Automation", *Conference Proceedings of the DA/DSM*, vol. 1, pp. 647-651, January 1994, Orlando, Florida.
2. Bass, R. M., Handran, D., Lambert, F.C., Kennedy, J. R., "Findings from the 1996 Olympic Games: Concentrated Charging and Power Quality", *Proceedings of the 1996 North American EV & Infrastructure Conference*, Vol. 1, December 12, 1996, San Diego, California. Lambert was responsible for the design and operation of the charging systems for the Electric Transportation System in the Olympic Village.

9. Bass, R. M., Handran, W. D., Abubaker, A. M., Lambert, F. C., and Kennedy, J. R., "Power Quality Impact of EV Charging on Utility Distribution Systems", *Proceedings of the 14th International Electric Vehicle Symposium*, December 16, 1997, Orlando, Florida. Lambert was project advisor and responsible for collecting power quality data from various electric vehicles.
10. Lambert, F.C., "Communications Modeling", *Proceedings of the 1998 North American EV & Infrastructure Conference*, Vol.1, December 3, 1998, Phoenix, Arizona.
11. Bass, R. M, Ronald Harley, Frank Lambert, Vinod Rajasekaran, Russell Davis, and Jason Pierce, "Secondary Distribution Harmonic Impacts of Residential EV Charging – Interim Report", *North American EV & Infrastructure Conference*, Vol.1, November 19, 1999, Atlanta, Georgia.
12. Richard Bass, Ronald Harley, Frank Lambert, Vinod Rajasekaran, and Jason Pierce, "Secondary Distribution Harmonic Impacts of Residential EV Charging", *Proceedings of the 17th International Electric Vehicle Symposium*, October 17th, 2000, Montreal, Quebec.
13. Richard Bass, Ronald Harley, Frank Lambert, Vinod Rajasekaran, and Jason Pierce, "Residential Harmonic Loads and EV Charging", *IEEE 2001 Winter Power Meeting*, January 30th, 2001, Columbus, Ohio.
14. Ronald Harley, Frank Lambert, Alisa Franklin, Pierre Clappier, Satish Rajagopalan, and McKinley Addy, "Power Quality Impacts of Airport GSE

Charging Systems", *IEEE 2003 Power Engineering Society General Meeting*, July, 2003, Toronto, Ontario.

15. Begovic, M.M., Radibratovic, B., Lambert, F.C., "On Multiobjective Volt-VAR optimization in Power Systems", *Proceedings of the 37th Annual Hawaii International Conference on System Sciences*, January 2004, pp. 59-64.
16. J. Mazumdar, R. Harley, T. Habetler and F. Lambert, "Using a neural network to discriminate between the contributions of the power electronic load and the power system to harmonic pollution", *Proceedings of the IEE International Power Electronics Conference (IPEC 2005)*, Niigata, Japan, pp. 874 – 878, April 4 – 8, 2005.
17. Joy Mazumdar, Ronald G Harley, Frank Lambert and Ganesh K. Venayagamoorthy, "Detection of Non-Linear Load Harmonics Using Neural Networks", *Proceedings of the International Conference on Power Systems Operation and Planning (ICPSOP 2005)*, Praia, Cape Verde, pp. 115 – 119, May 22 – 26, 2005.
18. J. Mazumder, R. G. Harley, F. Lambert, and G. K. Venayagamoorthy, "Using a neural network to distinguish between the contributions to harmonic pollution of non-linear loads and the rest of the power system", *Proceedings of the IEEE Power Electronics Specialist Conference (PESC05)*, pp. 1719-1725, Recife, Brazil, June 12- 16, 2005.
19. Joy Mazumdar, Ronald G Harley and Frank Lambert, "A Novel Method Based on Neural Networks to Distinguish Between Load Harmonics and Source Harmonics in a Power System", *Proceedings of the Inaugural IEEE Power Engineering Society 2005 Conference and Exposition in Africa (PES Durban 2005*), Durban, South Africa, July 11 – 15, 2005.
20. Joy Mazumdar and Ronald G. Harley and Frank Lambert, "System and Method for Determining Harmonic Contributions from Non-Linear Loads Using Recurrent Neural Networks", *Proceedings of the IEEE International Joint Conference on Neural Networks (IJCNN05*), Montreal, Canada, pp.366 - 371, July 31 – August 4, 2005.
21. Joy Mazumdar, R.G. Harley, and Frank Lambert, "System and Method for Determining Harmonic Contributions from Non-Linear Loads", *Proceedings of the 40th IEEE Industry Applications Society Annual Meeting (IAS 2005)*, 2-6 Oct. 2005, Hong Kong.
22. Joy Mazumdar, R. G. Harley and F. Lambert, " Identifying Harmonic Contributions from Non- Linear Loads Using Neural Networks", *Proceedings of the Intelligent Systems Applications in Power (ISAP) Conference*, November 7-10, 2005, Washington DC.
23. Joy Mazumdar, Ronald G Harley and Frank Lambert , "A Novel Method for Predicting Harmonic Current Injection from Non-Linear Loads Using Neural Networks", *Proceedings of the 31st Annual Conference of the IEEE Industrial Electronics Society (IECON'05)*, Raleigh, NC, November 7-10,. 2005.
24. J. Mazumdar, R. Harley, F. Lambert and G.K. Venayagamoorthy, "Predicting Load Harmonics in Three Phase Systems Using Neural

Networks," *Proceedings of the IEEE Applied Power Electronics Conference (APEC 2006)*, Dallas, Texas, Mar. 19 – 23, 2006.

25. Yi Yang; Lambert, F.; and Divan, D, "A Survey on Technologies for Implementing Sensor Networks for Power Delivery Systems", *IEEE Power Engineering Society General Meeting,* June 2007.
26. Rohit Moghe, Yi Yang, Deepak Divan and Frank Lambert, "A Scoping Study of Electric and Magnetic Field Energy Harvesting for Wireless Sensor Networks in Power System Applications", *IEEE Energy Conversion Congress and Expo,* San Jose, CA September 2009.
27. Debrup Das, Deepak Divan and Frank Lambert, "Integrated Fault Current Limiter and Power Flow Controller for Grid Tie-Lines", *IEEE Power Engineering Society General Meeting,* July 2009.
28. M. Steurer, B. Marchionini, F. Darman, F. Lambert and M. Noe, "Towards a Guide for Testing Emerging Fault Current Limiters", *CIGRE Session 2010*, Paris, August 2010.
29. Rohit Moghe, Yi Yang, Deepak Divan and Frank Lambert, "Design of a Low Cost
30. Self Powered "Stick-on" Current and Temperature Wireless Sensor for Utility Assets", *IEEE Energy Conversion Congress and Expo*, Atlanta, GA September 2010.
31. Frank Kreikebaum, Debrup Das, Yi Yang, Member, Frank Lambert and Deepak Divan, "Smart Wires – A Distributed, Low-Cost Solution for Monitoring Transmission Lines and Controlling Power Flows", *IEEE PES Innovative Smart Grid Technologies Conference Europe (ISGT Europe)*, 2010.
32. Rohit Moghe, Deepak Divan, Frank Lambert, "Powering Low-Cost Utility Sensors using Energy Harvesting", *Proceedings of the 2011-14th European Conference on Power Electronics and Applications (EPE 2011)*, September 2011.
33. Frank Kreikebaum, Dong Gu Choib, Frank Lambert, Valerie M. Thomas and Deepak Divan, "Increasing the Likelihood of Large-Scale Grid-Enabled Vehicle (GEV) Penetration through Appropriate Design Choices", *IEEE Vehicle Power and Propulsion Conference (VPPC)*, September 2011.
34. R. Moghe, A. Iyer, F. C. Lambert and D. Divan, "A Robust Smart Sensor for Smart Substations", *IEEE Power Engineering Society General Meeting,* July 2012.
35. Jorge E. Hernandez, Rajendra P. Kandula, Frank Lambert and Deepak Divan, "A Practical Directional Third Harmonic Hybrid Active Filter for Medium Voltage Utility Applications", *IEEE Energy Conversion Congress and Expo*, Raleigh, NC, September 2012.

II. TEACHING/INSTRUCTION/STUDENT DEVELOPMENT

A. <u>Continuing Education Courses Taught</u>

"High Voltage Engineering: Practices and Testing", September 23-27, 1996.

Lambert was a co-lecturer and was responsible for the laboratory sessions. Course evaluation data for Lambert was 86% Excellent and 14% Good. This course has been delivered in 1988, 1989, 1990, 1991, 1992, and 1993.

III. SERVICE

A. Professional Activities

1. President Elect, IEEE PES, 2018 – 2019.
2. VP Chapters, IEEE PES, 2014 – 2017.
3. Region 1-7 Representative, IEEE PES Governing Board, 2010 – 2013.
4. Chair, Region 3 PES Scholarship+ Committee, 2011 – 2016.
5. Member, Steering Committee, EPRI Electric Vehicle Infrastructure Working Council, 1997 - present.
6. Chairman, Plug-in Hybrid and Electric Vehicle Working Group, EPRI IWC, 2001 – present.
7. Secretary, IEEE PES Switching and Overcurrent Working Group, 2006 – 2012.
8. Secretary, IEEE PES Fault Current Limiter Testing Task Force, 2008 – 2016.
9. Member, CIGRE WG A3.23, Application and Feasibility of Fault Current Limiters in Power Systems, 2008 – 2012.
10. Member, IEEE PES Distribution Reliability Working Group, 2001-present.
11. Member, IEEE PES Working Group P1547.3 - Guide for Monitoring, Information Exchange and Control of Distributed Resources Interconnected with Electric Power Systems, 2002-2010.
12. Member, IEEE PES Distribution Automation (Smart Distribution) Working Group, 1992-present.
13. Member, IEEE PES Distribution Voltage Quality Working Group, 1995-2006.
14. Member, IEEE Power Engineering Career Promotion Subcommittee, 1992-2001.
15. Director, Atlanta Section IEEE, 1998-2000.
16. Chairman, SAE J2293 Electric Vehicle Charging Control Task Force, 1995-2001.
17. Chairman, Bus and Non-Road Charging Communication, Load Management, and Power Quality Committee, EPRI-IWC, 1997 - 2001.
18. Chairman, Charging Controls and Communication Committee, EPRI - Infrastructure Working Council, 1995-1999.
19. Secretary, Atlanta Section IEEE, 1997.
20. Director, Atlanta Section of IEEE, 1995-1996.
21. Finance Chair, IEEE Power Electronics PESC95 Conference, 1994-1995.
22. Chairman, Atlanta Chapter of IEEE Power Engineering Society, 1993-1995.
23. Vice-Chairman, Atlanta Chapter of IEEE Power Engineering Society, 1992-1993.
24. Secretary, Atlanta Chapter of IEEE Power Engineering Society, 1991-1992.
25. Treasurer, Atlanta Chapter of IEEE Power Engineering Society, 1990-1991.

26. Chairman, Custom Power Subcommittee, EPRI Custom Power Distribution Task Force, 1994.
27. Member, EPRI Distribution Task Force, 1992-1994.
28. Member, IEEE Digital Techniques in Electrical Measurements Subcommittee, 1983-1989.
29. Member, IEEE High Voltage Testing Techniques Subcommittee, 1982-1989.
30. Member, ANSI C119.4 Subcommittee on Overhead Connectors, 1983-1989.

B. On-Campus Committees

1. Welfare and Security Committee, Faculty of Georgia Tech, 1999-2005, Chairman 2003-2004 and 2004-2005.
2. Campus Master Plan Committee, 2003
3. Career Tracks Committee – GTRI, 2004-2005
4. AED Implementation Committee, Chairman 2005

C. Civic Activities

1. Chairman, Planning Commission, City of Chattahoochee Hills, 2008 - 2012
2. Member, Fulton County Board of Education, 1989-2002.
3. Member, South Fulton Chamber of Commerce, 1989-2002.
4. District Chairman, Boy Scouts of America, South Fulton District, 1998 – 2000.

IV. NATIONAL AND INTERNATIONAL PROFESSIONAL RECOGNITION

A. Honors and Awards

1. Chairman, IEEE Power Engineering Society Outstanding Chapter of the Year, 1994.
2. Senior Member, IEEE, 1987.

B. Professional Registration

1. Professional Engineer, State of Georgia, 1978.

C. Patents

U. S. Patent No. 7,013,227, “Method to Discriminate Between the Contributions of the Customer and the Power System to the Harmonic Disturbance”, Co-Inventors: Joy Mazumdar, Ron Harley, and Tom Habetler

U. S. Patent No. 7,722,951, “Insulator Coating and Method for Forming Same”, Co-Inventors: Jun Li, Lianhua Fan, and Ching-Ping Wong

Patents applied for:

1. "Durable Self Cleaning Superhydrophobic Surfaces with Application in External High Voltage Insulator Coatings", Co-Inventors: Yonghao Xiu, Lingbo Zhi, and Ching-Ping Wong
2. "Systems and Methods for Providing AC/DC Boost Converters for Energy Harvesting", Co-Inventors: Deepak Divan and Rohit Moghe
3. "Systems And Methods For Determining Current Flow Through A Utility", Co-Inventors: Deepak Divan and Rohit Moghe
4. "Self-Sustained Synchronous Rectifier", Co-Inventors: Deepak Divan and Ravi Nilakantan
5. "Multi-Core Triangulation Method for Current Sensing", Co-Inventors: Deepak Divan and Rohit Moghe
6. "A Low Cost Smart Voltage Sensor", Co-Inventors: Deepak Divan and Rohit Moghe

Invention disclosures:

1. "Method for Detection and Characterization of Fault Induced Delayed Voltage Recovery", Co-Inventors: Sakis Meliopoulos, George Cokkinides, Georgios Stefopoulos

D. Testimony before Legislative Committees

1. Lambert, F.C., "Superconductors and Electric Utility Applications", U.S. Congressional Briefing - Solving America's Electrical Problems: The Benefits of R&D, October 29, 2003, Washington, D.C.

E. Editorial and Reviewer Work for Technical Journals

1. Mr. Lambert periodically serves as reviewer for transactions grade papers submitted for publication in the IEEE Transactions on Power Delivery.

F. Expert Witness

1. Smith, Gambrell & Russell. LLP representing Blue Bird Body Company in a case involving performance of the electric drive system for their electric buses, 2000.
2. Quarles & Brady, LLP representing Meter-Treater, Inc. in a case involving failures of their meterbase surge arresters, 2001.
3. Jones, Cork& Miller LLP representing Georgia Power Company in a case involving a contact accident with a transmission line, 2005.

Statement of Support

By Burr C Passenheim

Subject: Proposed change in the National Electric Code (NEC)/NFPA 70 (Virginia Proposal T2701.1.1-18) to address risk of Electric Shock Drowning (ESD) at residential docks in Virginia.

I have reviewed the data, research and analysis developed by Mr. James Erler regarding ESD at residential docks. (http://erlerdesign.com/download/ESD_Review/) As an experienced expert in the design and analysis of electrical circuits and the underlying science surrounding electricity, and with particular experience in electrical grounding, I understand the materials that Mr. Erler has provided to me.

I agree with the following conclusions:

1. The grounding requirements in the 2017 NEC for residential docks form circuits that place intermittent voltages and currents on grounded dock structures that are sufficient to cause ESD injury or death.
2. Voltages and currents are delivered to grounded dock structures via the "green" ground conductor between the dock and house service panels.
    a. Claims by members of the National Fire Protection Association (NFPA) that the source of stray voltages/currents is some sort of current naturally flowing in the earth are false and not supported by scientific fact.
3. Grounded electrodes required in the NEC for installation at the house and dock are imperfect, resistive connections to the earth. The resistance of these connections to earth are too large to reduce the voltages on grounded structures to safe levels.
4. Removing the "green" ground conductor between the house and dock service panels removes the risk of ESD due to elevated ground voltages. There must be a separate earthed ground electrode at the dock that is connected to equipment ground. Equipment ground must NOT be connected to the neutral conductor from the electrical supply. In addition, all circuit breakers at the dock service panel must be 4 to 6 mA, personal protection, GFCIs.
    a. Claims by NFPA members that the "green" ground conductor is required for GFCIs to operate are false.
    b. Claims by NFPA members that GFCIs will not trip if there is a fault to a grounded structure connected to an earthed electrode are false.
    c. Statements in the NEC that the earth can never be used as a return conductor are correct when applied to neutral returns, but are incorrect when applied to ground fault interrupt devices such as GFCIs.
5. Between the 2014 NEC and the 2017 NEC, the requirement for 4 to 6 mA personal protection GFCI breakers was replaced with 30 mA equipment protection GFPE breakers. As ESD is caused by currents above 10 mA, this is a very dangerous change. All breakers at residential docks must be 4 to 6 mA personal protection GFCI breakers.

Name: Burr G Passenheim Date: 4/15/2020

Signature: Burr C Passenheim

Qualifications (please attach a resume/publications list or provide degrees and/or experience below):

PhD (physics) University of California (Riverside)

See Attached

Additional Comments:

BURR C. PASSENHEIM Ph.D.

3413 Rollsreach Dr
San Diego, CA 92111

Phone (858)737-4070 cell (505) 350-4996 e-mail passenheim@aol.com

RESUME

History:

General Atomic	1958-1965	Summer Employee
University of California at Berkeley	1959-1963	BA (Physics)
University of California at Riverside	1963-1968	MA/Ph.D. (Physics)
General Atomic	1968-1972	Research Scientist
IRT Corp.	1972-1978	Physics Group Leader
Mission Research Corporation	1978-1983	Group Leader
JAYCOR	1983-1994	Sr Principal Scientist
Journal Radiation Effects	1985-1986	Editor
Ingenuity Ink	1988-1990	Author/Publisher
San Diego State College	1994-1995	Post Grad Studies
Full Circle Research	1995-1998	Sr. Scientist
Maxwell Technologies	1998-2001	focal plane array testing
Science Applications Int Corp	2001-2005	Pulsed power facility

Areas of Expertise:

Radiation Effects	Device Physics	Cryogenics
Electromagnetics	Optics (UV-LWIR)	Magnetism
Electro-optics	Grounding/Shielding	Fast transient measurements
Data acquisition	Computer modeling	Technical Training
Technical marketing	Technical writing	Vacuum Technology
Inertial Instruments	Fiber optics	Detector technology

Science Applications International Corp.
Director of the Magnetic Flyer Plate (Pulsed power) Facility,
Developed end-to-end computer model.

Maxwell Technologies
Testing Infa-red focal plane assemblies.

Full Circle Research Senior Scientist
Single Event Testing
Designed and conducted optical and radiation tests of CCDs
Designed and conducted tests of shielded integrated circuit packages (RADPAK™)
Performed radiation transport and dose deposition calculations (ITS, SEA etc.)
Designed, built and used Roll Yaw apparatus to replicate omni-directional radiation.

JAYCOR: Senior Principal Scientist
Hardened and Tested Inertial Measurement Instruments.
Designed, built and tested optical instruments for nuclear tests.
Applied Electromagnetic shielding to Test equipment.
Characterized gas conductivity/plasma effects.
Analyzed fiber optic missile applications.
Measured fast optical phenomena (fi...

Invented and tested a radiation tolerant Photomultiplier.
Analyzed and tested Charge Coupled and MOS Devices.
Established Simulation Fidelity criteria for reentry vehicle radiation testing.
Determined consequence of interrupting interceptor missile guidance system.
Modeled and Tested magnetic thin film memories.
Served as Radiation Safety Officer.

Mission Research Corporation: Electromagnetics Group Leader

Designed and tested worlds most radiation tolerant photodiode.
Characterized spacecraft dielectric charging and discharging.
Characterized spacecraft "triggered" discharge.
Hardened and tested Ring Laser Gyroscopes to RV levels.
Hardened satellite-to-satellite laser communication system.
Established spectral fidelity of weapon simulator.
Designed test for air chemistry measurement.
Experimentally validated Nuclear Lightning initiation model.

General Atomic/IRT Corp: Research Scientist

Determined the effect of lithium on radiation damage to silicon.
Simulated nuclear radiation effects on magnetic materials.
Measured radiation effects on optical materials and fibers.
Developed model to explain optical radiation effects.
Devised technique to simulate thermo-mechanical effects.
Designed optical instruments for UV to LWIR applications.
Designed and Built Cryogenic (helium cooled) IR radiometer.
Built laser bi-directional reflectance apparatus (vis-LWIR).
Used ESR and IR spectroscopy to characterize radiation defects in solids.

University of California: Graduate Student

Developed technique to grow europium chalcogenide compounds.
Applied solid state physics models to magnetic compounds.
Measured low temperature heat capacity (0.3-20K) of magnetic materials.
Calibrated germanium resistance thermometer at ultra-low temperatures (T<1K).
Graded electromagnetics and taught mechanics Laboratory.
Operated Physics Dept. Computer and Wrote programs to do experiment data reduction..

Other Experience:

Performed experiments at more than 40 radiation test facilities.
Performed tests on six nuclear underground tests (UGTs).
Author of more than 40 publications and one book (How To Do Radiation Tests).

Reviewer of the **Journal of Radiation Effects** and **IEEE Trans Nuc Sci** (1975-95)
Editor of the **Journal of Radiation Effects** (1985-86).
Physics Instructor at San Diego City College (1970-71)
Member-at-Large Hardened Electronics and Radiation Tech.(HEART) Conference (1993-95)
Elected member of the IEEE Advisory Committee (1993-97)
Short Course Chairman 1988 HEART Conference
Clearances: DoD Secret and CNWDI, DoE Q.
Elected Senior Member of IEEE (1994)
Chairman: San Diego Chapter IEEE Nuclear and Plasma Sciences Society (1995-97)

BURR C. PASSENHEIM Ph.D.

3413 Rollsreach Dr
San Diego, CA 92111

Phone (858)737-4070 *cell (505) 350-4996* e-mail: passenheim@aol.com

"Magnetic Flier Plate Facility", with Darwin Brown. Scott Doane, and Neil Koozer **Journal of Radiation Effects, Research and Engineering**, V tbd ,pgs tbd, (2003).

"Compact X-Ray Simulator Design and Prototype Development" with K. Robertson, W. Rix, J. Rauch and A.R. Miller, to appear in **IEEE Trans Nuc Sci.** NS45, tbd, (1998)

"The Effects of Proton Irradiation on P-Channel CCD Imagers" with J.P. Spratt and R.E. Leadon, **1997 IEEE Radiation Effects Data Workshop** (1998)

"Effectiveness of IC Shielded Packages Against Space Radiation" with J.P. Spratt, R.E. Leadon, S. Clark and D. Strobel, to appear in **IEEE Trans Nuc Sci**, NS44, 2018, (1997)

"Radiation Testing Results of COTS Based Space Microelectronics" with Phil Layton, David Strobel, Hal Anthony, Robert Boss, Jim Marshall, John Parkinson and Jim Spratt to appear in **IEEE Trans Nuc Sci**, NS44, tbd, (1997)

"Gas Ionization Effects in Electronic Packages" with D.A. Walters, J.L. Sperling and G.E. Davis, to appear in **Journal of Radiation Effects, Research and Engineering**, V16 ,975. (1997)

"Gas Ionization Currents and IEMP in Integrated Circuit Packages" with D.A. Walters, H.A. Richeson, J.L. Sperling and G.E. Davis, **Journal of Radiation Effects, Research and Engineering**, V15, 56. (1995)

"Sensitivities of Predicted and Measured Box IEMP Responses to Details of Box Complexity and Radiation Exposure" with D. Walters, R. Leadon, D. Breuner, P. Coakley, C. Mallon and S. Lutjens, **Journal of Radiation Effects, Research and Engineering**, V14, tbd, (1995)

"Correlation of Digital and Analog Measurements of Box IEMP Upset in a Complex-Geometry Electronics Box" with D. Breuner, P. Coakley, R. Leadon, S. Lutjens, C. Mallon and D. Walters, **Journal of Radiation Effects, Research and Engineering**, V14,T.B.D. (1995)

"IEMP in High Density Interconnect Overlays; Analysis and Experiment" with R.E. Leadon, H. Richeson, T.M. Flanagan, Glen Forman, and James Loman, **Journal of Radiation Effects, Research and Engineering**, V12-3, 1, (Sept 1994)

"Evaluation of Radiation Induced Upset/Recovery of the Ground Based Interceptor Guidance Navigation and Control" with J. Wheeler, W. Seidler, J. Kulander, S. Gilardi, T. Ross and J.Pryor, **Journal of Radiation Effects, Research and Engineering**, V12-1A, 27, (1994)

"Experimental Evaluation of High Speed CCD Imager Radiation Effects Using Co60 and Proton Radiation" with T.L. Miller, D.A. Thompson, M.B. Elzinga, T.H. Lee, and R.E. Leadon, **1993 IEEE Radiation Effects Data Workshop,** 93TH0657-7, ISBN 0-7803-1906-0, 56, (1993).

"Radiation-Induced Transient Infrared Optical Effects in Sapphire, An Underground Test Measurement," with R. H. Stahl, C. E. Mallon, E. L. Follmer and H. Davis III, **Journal of Radiation Effects Research and Engineering**, Vol. 1R, 1990.

"Underground Testing (UGT) Spectrum Fidelity Issues for X-Ray-Induced IEMP and TREE Effects in Reentry Vehicle Electronics Subsystems," with W. Beezhold, D. E. Beutler, L. J. Lorence, W. P. Ballard, M. A. Hedemann, C. R. McClenahan, R. E. Craven, D. P. Knott, W. A. Seidler, **Journal of Radiation Effects Research and Engineering**, VIR, 1990.

"A Calculational Procedure for Gamma-Ray Box IEMP," with R. Leadon, D. Walters, W. Seidler, W. Beezhold and L. Lorence, **Journal of Radiation Effects Research and Engineering**, 7, 126, 1989.

"Characterization Limitations for Pulsed Bremsstrahlung Facilities," with W. Seidler, D. Walters, B. Kitterer, W. Beezhold, W. Ballard and D. Beutler, **Journal of Radiation Effects Research and Engineering**, V8, 1, 1989.

"Separating the Impact of IEMP and TREE Responses in a Simple Circuit," with D. Walters, W. Seidler, D. Breuner and A. Busdeker, **Journal of Radiation Effects Research and Engineering**, V8, 20, 1989.

"X-Ray Irradiation Simulation Fidelity Issues for Testing Reentry Vehicle Electronic Subsystems Using Harder-Than-Threat Aboveground Test Spectra: Part II," with W. P. Ballard, W. Beezhold, M. A. Hedemann, L. J. Lorence, Jr., C. R. McClenahan and W. A. Seidler, **Journal of Radiation Effects Research and Engineering**, V6, 58, 15 Dec 1988.

"A Radiation Tolerant Photodetector," with Robert O. Ginaven, **IEEE Trans. Nuc. Sci.**, 34, 1588, 1987.

"Variation of Box IEMP Response with Simulator Voltage," with W. Seidler, R. Kitterer, E. Wheatley, W. Beezhold, L. Lorence, Jr. and D. Shaeffer, **Journal of Radiation Effects Research and Engineering**, 5, 101, 1986.

"X-Ray Irradiation Simulation Fidelity Issues for Reentry Vehicle Electronic Subsystems," with W. Beezhold, L. J. Lorence, Jr., M. A. Stark, W. Seidler, B. Kitterer and D. L. Shaeffer, **Journal of Radiation Effects Research and Engineering**, 5, 146, 1986.

"Variation of Forward and Reverse Photoelectric Yield with Bremsstrahlung Energy," with

W. Seidler, B. Kitterer, W. Beezhold and M. Stark, **Journal of Radiation Effects Research and Engineering**, 5, 200, 1986.

"Limitations to the Stress Parameter Approach to Evaluating Simulation Fidelity," with W. Seidler, B. Kitterer and W. Beezhold, **Journal of Radiation Effects Research and Engineering**, 3, 1986.

"Progress in Nuclear-Induced Lightning," with J. D. Colvin, et al., **Journal of Radiation Effects Research and Engineering**, 2, 1, June 1984.

"X-Ray Triggered Discharge of Precharged Dielectrics," with J. D. Riddell, W. G. Vulliet, B. M. Goldstein and R. Stettner, **Journal of Radiation Effects Research and Engineering**, 2, 92, June 1984.

"Electrical Conductivity and Discharge in Spacecraft Thermal Control Dielectrics," with J. D. Riddell, V. A. J. van Lint and B. D. Kitterer, **IEEE Trans. Nuc. Sci.**, NS-29, 1594, 1982.

"Relating SGEMP Photon Test Exposures to Spacecraft Survivability Expectations," with V. A. J. van Lint and R. Stettner, **IEEE Trans. Nuc. Sci.**, NS-29, 1765, 1982.

"Charging and Discharging Teflon," with V. A. J. van Lint, Proceedings of the Spacecraft Technology Conference, 1980. **NASA Conf. Pub. 2182**, AFGL-TR-81-0270, 50, November 1980.

"Performance of Laser Systems in Radiation Environments,", with J. Holzer, **Optical Engineering**, 18, 562, December 1979.

"The Effect of Electron Precharging of SGEMP Response of Insulators," with V. A. J. van Lint, R. Stettner and D. A. Fromme, **IEEE Trans. Nuc. Sci.**, NS-26, 5024, December 1979.

"Monostatic and Bistatic Laser Reflectance of Engineering Materials," with J. T. Neu and R. S. Dummer, CLEOS "78", **IEEE/OSA Conference**, 7 February 1979.

"Nuclear Radiation Vulnerability of Ring Laser Gyroscopes," with C. E. Mallon, published by **SPIE Seminar Proceedings**, 157, 205, 1978.

" Radiation Effects on Optical Components," with M. J. Treadaway, **Society of Photo-Optical Instrumentation Engineers**, (Optics in Adverse Environments), 121, 67, 1977.

"Broadband Radioluminescence in Electron Radiation Ionic Compounds," with B. A. Green, **Journal of Applied Physics**, 48, 424, 1977.

"Radiation Coloration and Bleaching of Glass," with M. J. Treadaway, B. D. Kitterer and P. Schall, **IEEE Trans. Nuc. Sci.**, 23, 1852, 1976.

"Luminescence and Absorption of Electron Irradiated Common Optical Glasses, Sapphire and Quartz," with M. J. Treadaway and B. D. Kitterer, **IEEE Trans. Nuc. Sci.**, 22, 2253, 1975.

"IEMP in Plated-Wire Memories," with R. L. Fitzwilson, Proceedings of the AEC/DNA TREE/SGEMP Symposium, 14-17 January 1975.

"A Helium-Cooled Optical System for Low-Background Infrared Optical Measurements," with B. D. Kitterer, T. Flanagan, and R. Denson, **Rev. Sci. Instr.**, 45, 1365, 1974.

"Vulnerability of Magnetic Cores," with K. O. Downing, J. A. Naber, V. Kenyon, C. Vittoria and N. Tasslett, **Journal of Defense Research**, 2A, 563, 1972.

"Lithium - An Impurity of Interest in Radiation Effects in Semiconductors," **Radiation Effects**, 8, 239, 1971, same paper later appeared in Radiation Effects in Semiconductors, J. W. Corbett and G. D. Watkins (Eds), Gordon and Breach Science Publishers, 1971.

"Minority Carrier Lifetime Degradation and Anneal in Neutron-Irradiated Lithium-Diffused n-type Silicon," **Radiation Effects**, 2, 229, 1970.

"Production and Annealing of Defects in Lithium-Diffused Silicon After Irradiation with 30-MeV Electrons and Fission Neutrons at 300 C.," with J. A. Naber and R. A. Berger, **Proceedings of the Eighth Photovoltaic Specialists Conference**, August 1970. Published by the IEEE.

"Heat Capacity of RuO_2 and IrO_2 between 0.54 and 10 K," with D. C. McCollum, **Chem. Phys.**, 31, 320, 1969.

"Low-Temperature Heat Capacity of Europium Telluride," with D. C. McCollum, **Bull. Am. Phys. Soc.**, 13, 1645, 1968.

"Specific Heat of RuO_2 at Helium Temperatures," **Bull. Am. Phys. Soc.**, 13, 367, 1968.

"Low-Temperature Specific Heat of Arsenic," with D. C. McCollum, W. A. Taylor and H. W. White, **Phys. Rev.** 161, 652, 1967.

"Low-Temperature Specific Heat of EuS in a Magnetic Field," with D. C. McCollum and J. Callaway, **Phys. Letters**, 23, 634, 1966.

"Specific Heat of EuS at Liquid Helium Temperatures in a Magnetic Field," with

Statement of Support

By WILLIAM E. WHITLOCK

Subject: Proposed change in the National Electric Code (NEC)/NFPA 70 (Virginia Proposal T2701.1.1-18) to address risk of Electric Shock Drowning (ESD) at residential docks in Virginia.

I have reviewed the data, research and analysis developed by Mr. James Erler regarding ESD at residential docks. (http://erlerdesign.com/download/ESD_Review/) As an experienced expert in the design and analysis of electrical circuits and the underlying science surrounding electricity, and with particular experience in electrical grounding, I understand the materials that Mr. Erler has provided to me.

I agree with the following conclusions:

1. The grounding requirements in the 2017 NEC for residential docks form circuits that place intermittent voltages and currents on grounded dock structures that are sufficient to cause ESD injury or death.
2. Voltages and currents are delivered to grounded dock structures via the "green" ground conductor between the dock and house service panels.
    a. Claims by members of the National Fire Protection Association (NFPA) that the source of stray voltages/currents is some sort of current naturally flowing in the earth are false and not supported by scientific fact.
3. Grounded electrodes required in the NEC for installation at the house and dock are imperfect, resistive connections to the earth. The resistance of these connections to earth are too large to reduce the voltages on grounded structures to safe levels.
4. Removing the "green" ground conductor between the house and dock service panels removes the risk of ESD due to elevated ground voltages. There must be a separate earthed ground electrode at the dock that is connected to equipment ground. Equipment ground must NOT be connected to the neutral conductor from the electrical supply. In addition, all circuit breakers at the dock service panel must be 4 to 6 mA, personal protection, GFCIs.
    a. Claims by NFPA members that the "green" ground conductor is required for GFCIs to operate are false.
    b. Claims by NFPA members that GFCIs will not trip if there is a fault to a grounded structure connected to an earthed electrode are false.
    c. Statements in the NEC that the earth can never be used as a return conductor are correct when applied to neutral returns, but are incorrect when applied to ground fault interrupt devices such as GFCIs.
5. Between the 2014 NEC and the 2017 NEC, the requirement for 4 to 6 mA personal protection GFCI breakers was replaced with 30 mA equipment protection GFPE breakers. As ESD is caused by currents above 10 mA, this is a very dangerous change. All breakers at residential docks must be 4 to 6 mA personal protection GFCI breakers.

Name: WILLIAM E. WHITLOCK Date: 30 APRIL 2020

Signature: William E. Whitlock

Qualifications (please attach a resume/publications list or provide degrees and/or experience below):

SEE ATTACHED FILE: Whitlock RESUME v1.2.pdf

Additional Comments:

SEE ATTACHED FILE: Supplement to Whitlock Resume - ESD.pdf

Supplement to file: Whitlock RESUME v1.2.pdf

1. Under “Awards,” most of the honors listed were due to my extensive original research in, and knowledge of electronic system grounding – which, by default, is the equipment grounding conductor, or EGC, in the premises AC power distribution system. Since my training is in electronics, I very clearly understand the effects of multiple currents in EGC and external neutral and earth-ground conductors, the effects of magnetic induction in parallel circuit conductors, and an especially clear understanding of how GFCI devices actually work.

2. Under “Publications,” is a link to an example of the educational seminars I’ve presented for over 25 years. In those seminars, I explain how significant voltage differences are generated by earth to neutral connections in the external (to a building) AC power distribution system.

3. Several years ago, I served as consultant to the electrical contractor in modifying premises wiring for the purpose of minimizing voltage differences within the EGC network of the Bing Auditorium at Stanford University.

4. I’ve been very recently engaged to advise the electrical contractor in implementing the same voltage difference reduction in a new 90,000 sq ft test facility being built by Apple, Inc. in Cupertino, CA.

William E. Whitlock

30 April 2020

WILLIAM E. (BILL) WHITLOCK

642 College Drive, Ventura, CA 93003

Phone: (805) 755-5018, Mobile: (805) 890-7620, E-Mail: engineer_bill@verizon.net

SKILLS and CAREER SUMMARY

- **Skilled Analog & Mixed Signal Circuit Designer** (40+ years)
- **Experienced Technical Team Manager** (40+ years)
- **Signal Integrity & EMC Problem Solver** (25+ years)
- **Technical Writer & Instructor** (25+ years)

My circuit designs are often described as novel, simple, elegant, reliable, and cost-effective. I have a solid track record of innovation, including several patents, that has resulted in hugely successful products for my employers. In most cases, the products were the first of their kind – replacing industry "vaporware" with real hardware. Since 1972, my jobs have included managing a staff of other engineers and technicians, varying from 3 to 15, and routinely working with other engineering professionals such as PCB designers, software developers, purchasing, industrial designers, and marketing. I've often developed a product from concept to prototype.

Since 1995, I've become widely-known as the "guru of grounding" and system noise reduction – often solving noise problems that eluded other consultants. I'm a published technical writer, having created hundreds of product data sheets, application notes, and tutorials as well as writing book chapters, "white papers," and columns for trade magazines. Since 1994, I've created and presented technical tutorials to trade convention and university audiences worldwide. I've also held both secret and top-secret ("Q") security clearances over my career. I'm proficient with Microsoft Office (Word, Excel, Outlook, PowerPoint) and several schematic capture and circuit-simulation programs.

PROFESSIONAL EXPERIENCE

2014 – now Principal Engineer, Whitlock Consulting, 642 College Drive, Ventura, CA

I've done consulting as time permits, but only with employer approval, since 1970. Projects have included complete product designs (concept to prototype), circuit modifications, custom filters, product testing/evaluation, on-site troubleshooting/diagnosis of "ground-loop" noise issues, and basic feasibility research. A client list available on request.

1989 – 2014 President/Chief Engineer, Jensen Transformers, 9304 Deering Ave., Chatsworth, CA

In 1989, Jensen designed, manufactured, and distributed high-performance audio transformers for industry OEMs only. I inherited the company from colleague and company founder Deane Jensen upon his death in 1989. At the time, it had 6 employees, serious legal problems, and was deeply in debt. I revived it by creating a new plug-and-play product line, which incorporated the transformers, and found a much larger market. I also created new data sheets for the standard product line (about 100 models).

This included creating standard test circuits and parameter measurements, tutorial application notes, and over a hundred application schematics. When I sold Jensen in 2014, it had 16 employees, was debt-free, and enjoyed yearly revenues of nearly $2 million.

1981 – 1989 Manager of Electronic Development, Capitol Records, 1750 N. Vine St., Hollywood, CA

In 1981, Capitol Records was a highly vertically-integrated record label. They owned their own recording studios, manufactured their own vinyl records (including mastering lacquer discs), cassettes (including both tape and cassette shells), and compact discs, as well as a distribution arm. My department developed specialized electronics to upgrade performance of the recording, mastering, and high-speed cassette duplication signal chains. I managed a staff (2 other engineers, 3 technicians) to develop and manufacture electronics that were retrofitted into hundreds of cassette duplication machines in Capitol plants around the world as part of the XDR program. I also headed development of the first-ever digital "loop-bin" system, using a large RAM array to replace the high-speed (120"/sec) mechanical tape loop player in these systems – a frequent cause of factory down-time. I was also involved in developing QC instrumentation for Capitol's new CD manufacturing plants. I resigned when a newly-appointed Capitol CEO announced plans to phase-out most R&D operations.

1974 – 1981 Chief Engineer, Laser Images, Inc., 6911 Hayvenhurst Ave., Van Nuys, CA

I joined Laser shortly after its founding. It had 3 employees who produced it's "Laserium" laser light show, using hand manipulation of optical "devices," at Griffith Park planetarium in Los Angeles. They asked me to develop automation electronics to control the optical devices in the laser projector. In the course of this work, I developed and patented a digital audio recording system based on modified VHS tape players. I also developed one of the first high-efficiency "class-D" power amplifiers using newly-introduced power MOSFETs to drive optical scanning devices. The automated projectors allowed rapid expansion of show venues (over 20 of the world's largest planetariums) and hiring 100 new employees by the late 70's. A series of upper management blunders crippled the business by 1980 … and I resigned.

EDUCATION

1963 – 1965 Pinellas Technical College, Clearwater, FL – Associate in Electronics Technology

When I enrolled, this school had just opened, but became fully accredited shortly after my graduation.. The electronics technology program consisted of 6 trimesters, but I took final exams for the first two trimesters, hastening my graduation. The curriculum included related courses such as chemistry, strength of materials, micro-assembly, and public speaking. Due to my work experience as a bench TV service technician, my professor let me teach TV technology in my last trimester. I graduated with honors in 1965.

1962 – 1963 St. Petersburg Junior College, St. Petersburg, FL – (no degree)

I enrolled in the engineering program but dropped out in the second semester because I was frustrated with taking courses like English literature and other non-engineering requisites. I was perhaps overly anxious to take "real" engineering classes and dropped out in my 3rd semester.

1960 - 1962 Northeast High School, St. Petersburg, FL - Diploma

Following the launch of Sputnik in 1957, the Florida school system started an "Accelerated Arts and Sciences" program. For the first time, students could take chemistry, physical science, Algebra I through III, plane geometry, and solid geometry in high school. I opted into the program and made excellent grades. I also had the 5th highest SAT score among about 200 graduating seniors.

AWARDS

2012 Audio Engineering Society Life Fellow Award

Because of my body of work, especially in advancing the industry's knowledge of grounding, shielding, and signal integrity issues, I was awarded Fellow status.

2010 NSCA Technical Instructor of the Year Award … and again in 2011

Awarded by the National System Contractor Association (NSCA) by a vote of students who attended dozens of technical seminars at the annual NSCA conventions.

2009 Institute of Electrical & Electronic Engineers Life Senior Status

Because of my body of industry knowledge contributions, I was advanced to Senior member.

2007 Invited Lecturer at MIT

My lecture was about "Grounding" and its implications at both the circuit and system level. I did several lectures the same day, first to two classes of EE students and, in the evening, to a broader audience of about 300, including a number of physics and electronics professors … who unanimously admitted that their own coverage of this fundamental topic was rather superficial.

OTHER TECHNICAL ACTIVITIES

2008 Underwriter's Laboratory Advisory Panel Member

I was invited to join this advisory group on professional audio equipment and I'm still intermittently involved in approvals of proposed new safety standards and/or revisions of existing ones.

1995 AES and IEC Standards Organizations

The Audio Engineering Society creates and maintains standards for the industry. I remain an active member of SC-05-05, the working group on Grounding and Shielding, and was its chairman for several years.

In 1999, the IEC (perhaps the largest standards organizations in the world) put out a "call for comment" on their Standard 60268-3, a test for common-mode rejection in balanced interfaces. Test results seemed to have little correlation with real-world results. I suggested procedural changes that were adopted by the IEC in 2000.

1966 Institute of Electrical & Electronic Engineers Membership

I became very interested in the knowledge base of the IEEE in college. Over the years, I've been a member of several IEEE "societies" such as solid-state circuits, circuits and systems, electromagnetic compatibility, and others. I've presented tutorials to local IEEE chapters several times and continue to be an active member.

1966 Audio Engineering Society Membership

I have a very long-standing interest in music and the technical side of its production and reproduction. I joined the AES in college and became quite active in 1972, after getting my first job in the professional audio industry. I continue to actively participate in national conventions and local chapter activities, including tutorial presentations.

PATENTS

2012 RCA-Compatible Connectors for Balanced and Unbalanced Interfaces, US Pat 8,100,715

So-called "RCA" connectors are the de-facto standards in consumer audio equipment. This patent describes a 3-contact male and female connector that are physically compatible with existing 2-contact versions. The cable then is a shielded, twisted pair with the invented 3-contact male plugs at each end. The added contact is arranged so that it, along with the center-pin, become the balanced signal pair but, when connected to a conventional 2-RCA-compatible mate, the "low' side of the balanced line is tied to the "ground" contact automatically. This enables the noise rejection properties of a balanced line even when the signal source is a conventional unbalanced output and 2-contact connector. Of course, maximum benefit is achieved when both output and input sockets are 3-contact balanced types described in the patent.

https://patents.google.com/patent/US8100715

2011 Power Cable with Twisted and Untwisted Wires … US 2012/0103646A1 (provisional)

My colleague Jamie Fox, an electrical power engineer, is co-inventor. The wire arrangement minimizes magnetic coupling between current-carrying conductors and safety-ground conductor, thus minimizing voltage induced into the ground conductor and, subsequently, the system equipment grounds. It is this voltage that is the root-cause of "ground loop" issues.

http://www.patentsencyclopedia.com/imgfull/20120103646_01

1998 Continuous Feed-Forward AC Voltage Regulator, US Pat 6,653,824

This invention is an AC voltage regulator which includes a feed-forward circuit and a differential amplifier that continuously compares the incoming AC voltage to a locally-generated, amplitude-stabilized, and phase-locked reference waveform. The output of the differential amplifier drives a power amplifier whose output is arranged to continuously buck or boost the incoming AC voltage. This corrects both the amplitude and waveform distortions, creating a pure waveform and constant output voltage.

https://patents.justia.com/patent/6653824

1994 Differential Line Receiver with Common-Mode AC Bootstrapping, US Pat 5,561,561

A bootstrapped audio line receiver that receives a differential-mode input signal and outputs a single-ended signal. The inputs provide a DC current path to a ground terminal while maintaining a very high input common-mode impedance to AC signals. The inputs include a bootstrapped RF filter that removes RF noise without adversely affecting common-mode rejection at audio frequencies. In one embodiment, the input amplifier includes two operational amplifiers connected for unity gain and having two bias resistors connected in series between each input terminals of the input amplifier and a ground terminal. A capacitor is connected from the output of each operational amplifier to a node between each set of series connected bias resistors and prevents the low impedance of the bias resistors from significantly degrading the line receiver's common-mode rejection ratio. Thus, the line receiver tolerates a wide range of balanced and unbalanced sources with a minimal deterioration of the line receiver's CMRR.

https://patents.google.com/patent/US5568561A/en

1977 Pulse Code Modulated Digital Audio System, US Pat 4,030,129

The patent describes a method of using a rotary-head tape transport (as in VHS and Betamax video recorders) to record and playback digitized serial PCM-encoded audio signals and auxiliary data. Data formatting and framing circuits are described that minimize the effects of the timing irregularities peculiar to such tape transports as well as a novel method of concealing the effects of "drop-outs" they are also prone to.

https://patents.google.com/patent/US4030129A/en

PUBLICATIONS

1995 "Balanced Lines in Audio Systems: Fact, Fiction, and Transformers"

Journal of the Audio Engineering Society

The theoretical benefits of balanced audio interconnection schemes are discussed as well as fundamental but widely unrecognized mechanisms that limit real-world performance. The venerable audio transformer enjoys several inherent advantages over the so-called active circuits offered to replace it in audio equipment. Today, as improved digital recording systems demand increased system dynamic range, these advantages are becoming ever more important.
https://www.researchgate.net/publication/294765837_Balanced_lines_in_audio_systems_fact_fiction_and_transformers

2015 "Handbook for Sound Engineers," 5th edition *(also 3rd and 4th editions)*

Focal Press

Handbook for Sound Engineers is the most comprehensive reference available for audio engineers, and is a must read for all who work in audio. With contributions from many of the top professionals in the field, including Glen Ballou on interpretation systems, intercoms, assistive listening, and fundamentals and units of measurement, David Miles Huber on MIDI, ***Bill Whitlock on audio transformers and preamplifiers***, Steve Dove on consoles, DAWs, and computers, Pat Brown on fundamentals, gain structures, and test and measurement, Ray Rayburn on virtual systems, digital interfacing, and

preamplifiers, Ken Pohlmann on compact discs, and Dr. Wolfgang Ahnert on computer-aided sound system design and room-acoustical fundamentals for auditoriums and concert halls, the Handbook for Sound Engineers is a must for serious audio and acoustic engineers.
https://www.academia.edu/38318764/handbook-for-sound-engineers-pdf_8993935.pdf

1998-2003 "Clean Signals" Column

Sound & Video Contractor Magazine

As indicated at the URL below, this column in a very popular trade magazine covered a wide range of signal interfacing issues. Between 1995 and 2014, I wrote for many other magazines as well.
https://www.svconline.com/author/bill-whitlock

2009 "Hum, Buzz, and Ground Loops: New Insights into an Old Problem" Seminar Presentation

I've presented at least 100 seminars on this general topic at trade show conventions, universities, and large companies from 1994 to the present. PowerPoint slides from a typical seminar can be found at: http://centralindianaaes.files.wordpress.com/2012/09/indy-aes-2012-seminar-w-notes-v1-0.pdf Live video excerpt from a presentation in Berlin can be found at: http://www.aes.org/live/?ID=218

Bill Whitlock

Principal Engineer

Whitlock Consulting

642 College Drive
Ventura, CA 93003
E-mail: engineerbill@ieee.org
Office: (805) 755-5018
Mobile: (805) 890-7620

Audio Engineering Society Life Fellow

IEEE Life Senior Member

ANALOG CIRCUIT DESIGN
ANALOG SIGNAL INTERFACING
ELECTRONIC PRODUCT DESIGN

40+ Years of Innovative Design Experience

- Product Design from Concept to Prototype
- Advanced Knowledge of Grounding & AC Power
- Troubleshooting of System Noise Problems
- Extensive Background in Professional Audio
- Member of UL Advisory Committee on Pro Audio
- Specialty Filters and Signal Processing Circuitry
- Design Reviews and Failure Analysis
- Technical Writing and Teaching
- 5 US Patents

Statement of Support

By RONALD M BAUMAN

Subject: Proposed change in the National Electric Code (NEC)/NFPA 70 (Virginia Proposal T2701.1.1-18) to address risk of Electric Shock Drowning (ESD) at residential docks in Virginia.

I have reviewed the data, research and analysis developed by Mr. James Erler regarding ESD at residential docks. (http://erlerdesign.com/download/ESD_Review/) As an experienced expert in the design and analysis of electrical circuits and the underlying science surrounding electricity, and with particular experience in electrical grounding, I understand the materials that Mr. Erler has provided to me.

I agree with the following conclusions:

1. The grounding requirements in the 2017 NEC for residential docks form circuits that place intermittent voltages and currents on grounded dock structures that are sufficient to cause ESD injury or death.
2. Voltages and currents are delivered to grounded dock structures via the "green" ground conductor between the dock and house service panels.
    a. Claims by members of the National Fire Protection Association (NFPA) that the source of stray voltages/currents is some sort of current naturally flowing in the earth are false and not supported by scientific fact.
3. Grounded electrodes required in the NEC for installation at the house and dock are imperfect, resistive connections to the earth. The resistance of these connections to earth are too large to reduce the voltages on grounded structures to safe levels.
4. Removing the "green" ground conductor between the house and dock service panels removes the risk of ESD due to elevated ground voltages. There must be a separate earthed ground electrode at the dock that is connected to equipment ground. Equipment ground must NOT be connected to the neutral conductor from the electrical supply. In addition, all circuit breakers at the dock service panel must be 4 to 6 mA, personal protection, GFCIs.
    a. Claims by NFPA members that the "green" ground conductor is required for GFCIs to operate are false.
    b. Claims by NFPA members that GFCIs will not trip if there is a fault to a grounded structure connected to an earthed electrode are false.
    c. Statements in the NEC that the earth can never be used as a return conductor are correct when applied to neutral returns, but are incorrect when applied to ground fault interrupt devices such as GFCIs.
5. Between the 2014 NEC and the 2017 NEC, the requirement for 4 to 6 mA personal protection GFCI breakers was replaced with 30 mA equipment protection GFPE breakers. As ESD is caused by currents above 10 mA, this is a very dangerous change. All breakers at residential docks must be 4 to 6 mA personal protection GFCI breakers.

Name: Ronald M Bauman Date: 30 April 2020

Signature: Ronald M Bauman

Qualifications (please attach a resume/publications list or provide degrees and/or experience below):

BSEE LEHIGH UNIVERSITY 1963
DARPA PROGRAM MANAGER
CEO INSOUND AUDIO INC - manufacturer of high end audio equipment
may contact me if necessary: insound@insoundaudio.com

Additional Comments:

Agree that the current codes need to change especially with regard to water safety. The proposed changes appear to be based on sound engineering analysis. The safety of current codes needs to be tested by a group of objective engineers.

Statement of Support

By Robert A. Lowell

Subject: Proposed change in the National Electric Code (NEC)/NFPA 70 (Virginia Proposal T2701.1.1-18) to address risk of Electric Shock Drowning (ESD) at residential docks in Virginia.

I have reviewed the data, research and analysis developed by Mr. James Erler regarding ESD at residential docks. (http://erlerdesign.com/download/ESD_Review/) As an experienced expert in the design and analysis of electrical circuits and the underlying science surrounding electricity, and with particular experience in electrical grounding, I understand the materials that Mr. Erler has provided to me.

I agree with the following conclusions:

1. The grounding requirements in the 2017 NEC for residential docks form circuits that place intermittent voltages and currents on grounded dock structures that are sufficient to cause ESD injury or death.
2. Voltages and currents are delivered to grounded dock structures via the "green" ground conductor between the dock and house service panels.
    a. Claims by members of the National Fire Protection Association (NFPA) that the source of stray voltages/currents is some sort of current naturally flowing in the earth are false and not supported by scientific fact.
3. Grounded electrodes required in the NEC for installation at the house and dock are imperfect, resistive connections to the earth. The resistance of these connections to earth are too large to reduce the voltages on grounded structures to safe levels.
4. Removing the "green" ground conductor between the house and dock service panels removes the risk of ESD due to elevated ground voltages. There must be a separate earthed ground electrode at the dock that is connected to equipment ground. Equipment ground must NOT be connected to the neutral conductor from the electrical supply. In addition, all circuit breakers at the dock service panel must be 4 to 6 mA, personal protection, GFCIs.
    a. Claims by NFPA members that the "green" ground conductor is required for GFCIs to operate are false.
    b. Claims by NFPA members that GFCIs will not trip if there is a fault to a grounded structure connected to an earthed electrode are false.
    c. Statements in the NEC that the earth can never be used as a return conductor are correct when applied to neutral returns, but are incorrect when applied to ground fault interrupt devices such as GFCIs.
5. Between the 2014 NEC and the 2017 NEC, the requirement for 4 to 6 mA personal protection GFCI breakers was replaced with 30 mA equipment protection GFPE breakers. As ESD is caused by currents above 10 mA, this is a very dangerous change. All breakers at residential docks must be 4 to 6 mA personal protection GFCI breakers.

Name: Robert A. Lowell Date: April 12, 2020

Signature: Robert A Lowell

Qualifications (please attach a resume/publications list or provide degrees and/or experience below):

PDF's of Resume and work history:
EMP, SGEMP and EMC Mitigation

Additional Comments:

At TRW (Redondo Beach, CA, was responsible for developing and qualifying by lab tests the effectiveness of grounding & shunting measures to protect satellites against EMP, EMI & SGEMP

1.1.1 Robert A. Lowell

Education and Certifications

Graduate Courses in Satellite Communications, Electromagnetics, USC, 1979-82
MS Physics - Northeastern Univ ABD, 1972-75
BS Physics – Worchester Polytechnic Institute, 1969

Security Clearances **: TS/SCI, CNWDI**

Title : Senior Radiation Scientist

Years of relevant Experience **: 47**

Developed the first Flash Xray machines and performed the first SGEMP and IEMP experiments to understand and model the phenomena over a full range of cavity dimensions and air pressures (1972-4). Developed the first cable SGEMP database for TRW (1974-6). Developed the first Xray hardened cable (w Raychem). Used these SGEMP and IEMP models at TRW (1977-82) to construct full system response models of AF/Navy/OGA satellites, including DSP 14, Milstar, SBIRS High. Pioneered development of a combined SGEMP/TREE satellite model for full 3D representation of spacecraft with solar arrays and antenna's, focusing on the energy coupled into the system from all effects simultaneously. Developed hardening solutions for structural shielding and mitigation schemes for payload aperture and thermal penetrations.

Was an integral part of the SENSOR UGT Team that fielded the Hunter's Trophy experiment on an 8 deg K Homing Sensor to demonstrate Operate Through for sensor systems at very high Xray fluence levels (classified). Documented knowledge in the Sensor Hardening Protocol (1993-96). Was specifically responsible for the design and validation of the EM shielding of the Homing Interceptor structure in concert low response cable and connector design and fabrication.

At Northrop Electonics, headed a group focused on radiation analysis, support of design hardening, and verification of MX Missile Inertial Measurement Unit. Lead test team for Xray OT and Survive threshhold verification at Aurora FXR and performed flyout simulations to prove missile Delta CEP requirements were met in presence of multiple nuclear bursts. At Kaman Sciences, as sub to Northrop Advanced Systems Div, managed the nuclear assessment, hardening and verification of the B2 bomber against TREE, EMP and Human effects. Personally wrote the detailed requirements and test plan for box, subsystem and system-level EMP verification testing – the latter not actually performed until the system went operational.

Awards and Honors:

Accommodation letter from Gen Kritikowski (MilStar AF PM) for verifying the MilStar satellite SGEMP thresholds for Upset and Burnout (1991),indicating adequate System-level Xray test (>$20M)

Relevant Publications:

1) Gamma SGEMP Hardening Handbook for Army HDL, 1988
2) Box IEMP Hardening Handbook for DTRA (lead Author), 1991
3) Passive Sensor Hardening and Validation Protocol, 1996
4) For Industry, lead author on the Satellite Nuclear Hardening Handbooks for TRW (1982), and as a consultant, subsequent Handbooks: Lockheed (FEWS-SBIRS); Boeing (TSAT, 2007-2008)

5) Multiple JRE papers on Nuclear Modeling, Hardening and Verification Testing of Communications (FSC,Milstar) and Surveillance Satellites (SSTS, SBIRS,SBSS), 1988-1997

AUDUBON SOCIETY
NORTHERN VIRGINIA

11100 Wildlife Center Drive, Suite 100
Reston, VA 20190
(703) 438-6008 • info@audubonva.org
audubonva.org

June 26, 2020

Sent via email: Kyle.Flanders@dhcd.Virginia.gov

Kyle Flanders
Department of Housing and Community Development
Main Street Center
600 East Main St. Suite 300
Richmond, VA, 23219

Re: Virginia Uniform Statewide Building Code [13 VAC 5-63]
Update the Uniform Statewide Building Code

Dear Mr. Flanders:

I write on behalf of the more than 4,500 members of Audubon Society Northern Virginia (ASNV) to recommend that bird-friendly building design and related bird deterrent materials be required by the Virginia Uniform Statewide Building Code for both new and renovated commercial and residential structures.

The mission of ASNV is to conserve and restore natural ecosystems, focusing on birds, other wildlife, and their habitats for the benefit of humanity and the earth's biological diversity. Over the last 50 years, North America has lost over 3 billion birds.[1] The greatest loss arises from habitat loss but building and window collisions are another significant factor in bird deaths. An estimated 300 million to 1 billion birds are killed each year from such collisions.[2]

Both commercial and residential structures can be designed and built to include bird collision deterrent measures and use bird-safe building materials and design features. Recognizing the importance of this issue, the New York City Council passed a bill (https://legistar.council.nyc.gov/LegislationDetail.aspx?ID=3903501&GUID=21B44B73-D7E1-4C55-83BD-1CA254531416&Options=&Search=) on December 11, 2019 that will update their building code with design and construction requirements aimed at

[1] Rosenberg, Kenneth V., et al., Decline of the North American avifauna, *Science*, Vol. 366, No. 6461, pp. 120-124.
[2] National Audubon Society, https://www.audubon.org/news/two-bills-introduced-reduce-building-collisions-and-protect-seabirds.

making buildings safer for migratory birds. This code change is scheduled to take effect in December 2020.[3]

The Commonwealth of Virginia should follow New York City's important lead and update the Uniform Statewide Building Code for both commercial and residential structures to include bird collision deterrent design and bird-safe materials in all new building construction and renovation. These standards are covered in more detail in the (1) American Bird Conservancy's Bird-friendly Building Design publication: https://abcbirds.org/program/glass-collisions/bird-friendly-design/, and in (2) the U.S. Green Building Council's LEED pilot credit #55: https://leeduser.buildinggreen.com/credit/Pilot-Credits/SSpc55#tab-credit-language.

Accordingly, ASNV recommends modifying the Virginia Uniform Statewide Building Code, where needed, to require the use of bird collision deterrent measures and bird-safe building materials and design features in all new and renovated commercial and residential buildings throughout the Commonwealth of Virginia. The Audubon Society of Northern Virginia looks forward to collaborating with you on this. If you have any questions please contact me at President@audubonva.org

Sincerely,

Tom Blackburn
President

1637 Cecile Street
McLean VA 22101
703-821-0624

[3] "Death from Above: Lawmaker Envisions Bird-Safe Buildings in New York City", *Newsweek*, January 24, 2019.

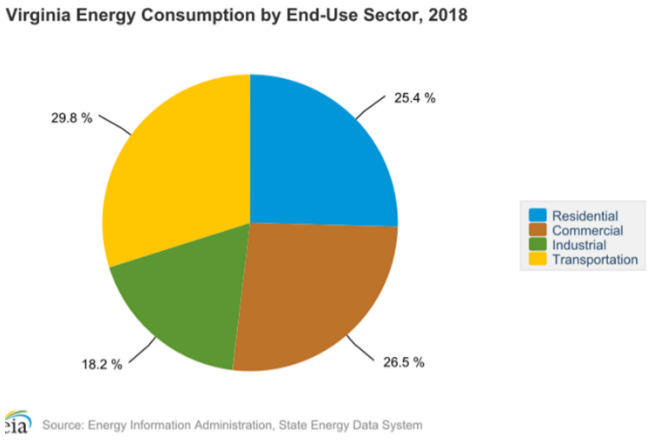
Commonwealth of Virginia
Before The
Board of Housing and Community Development

COMMENTS ON PROPOSED AMENDMENTS TO THE UNIFORM STATEWIDE BUILDING CODE FROM THE FAITH ALLIANCE FOR CLIMATE SOLUTIONS (FACS)

The Faith Alliance for Climate Solutions, a 501c3 nonpartisan interfaith organization in Northern Virginia, submits comments on the pending proposal to update Virginia's Uniform Statewide Building Code (USBC) for residential construction.

STATEMENT OF INTEREST

These comments are submitted by the Faith Alliance for Climate Solutions, an organization with more than 75 faith communities and 2,400 faith-based activists in Northern Virginia whose mission is to develop local solutions to climate change. Accelerating climate disruption caused by burning fossil fuels makes action to cut greenhouse gas emissions imperative and urgent. The US Energy Information Administration reports that commercial and residential buildings consume 52% of Virginia's energy. Residential buildings consume 25.4% of the state's total energy use, a total of 610.2 trillion BtUs in 2018. Reducing energy use through improved efficiency buildings can cut greenhouse gas emissions. Importantly, the small upfront construction costs to improve building efficiency produce substantial savings in utility bills for owners and renters. Residents experience improved comfort of their homes, reduced utility bills and increased resale value. All of us benefit from cutting carbon emissions. It is far better that residences (and commercial buildings) be designed and constructed to optimize energy efficiency than to retrofit inadequately designed buildings in the future. Many states, including Virginia's neighbors Maryland, DC and North Carolina, have more rigorous residential building efficiency codes than Virginia's. The American Council for an Energy-Efficient Economy (ACEEE) ranks Virginia's building codes as 29th, below even Florida, Texas and Nevada.



SUMMARY OF RECOMMENDATIONS

We urge the BHCD to adopt the following changes to the residential energy efficiency provisions of the USBC:

- **Meet or exceed 2018 IECC energy conservation standards for all forms of construction covered by the USBC.** Virginia's USBC has fallen far behind international standards and behind the standards of most states. The current residential USBC generally conforms to the 2009 IECC. The current 2018 IECC standards and the soon to be released draft 2021 standards specify floor, wall, ceiling and fenestration insulation standards that are more rigorous than Virginia's USBC. The IECC 2018 standard requires lower air infiltration than the USBC. Home builders in more than half the states are constructing homes to energy efficiency standards that are more rigorous than Virginia's. Building homes to the less efficient USBC codes puts homeowners at a competitive disadvantage to homeowners in Maryland, DC, North Carolina when reselling their homes. The small added initial costs to meet or exceed the 2018 IECC efficiency standards will result in benefits to homeowners and the environment, while not impacting the competitiveness of home builders in the state and inter-state market. As energy efficiency standards continue to be strengthened by IECC, BHCD should consider emulating Maryland's requirement that new IECC standards be adopted within 12 months of their publication.

- **Specifically, the BHCD should adopt the 2018 IECC residential codes for new construction:**
    - Require builders meet or exceed the 2018 IECC standards for envelope efficiency – particularly for walls and ceilings. Do not extend Virginia's outdated 2009 residential building energy efficiency standards for another three years.
    - Require builders to have third party blower door tests and to limit air infiltration to 3 air changes per hour or less. Three exchanges has been the IECC standard since 2012.
- **Meet or exceed the 2018 energy efficiency standards for major renovations of residential and commercial buildings.** Virginia Code Section 36-99.01 recognizes the "urgent need to improve the housing conditions of low- and moderate-income individuals and families [and] to improve the existing condition of many of the Commonwealth's stock of commercial properties." The 2018 IECC standards for renovations of existing commercial and residential buildings should meet or exceed the same level of efficiency as in new buildings.

Justification for Virginia USBC to adopt the 2018 IECC energy efficiency standards

Virginia should adopt the 2018 International Energy Conservation Code (IECC) without alteration. The amendments that weakened the energy efficiency requirement of the 2012 IECC should be eliminated. Virginia routinely adopts the full IECC for commercial construction. Virginia's energy efficiency codes for multi-unit dwellings are the IECC commercial codes. The

standard for renovation of existing residential buildings is the IECC (601.4 and 602.3.4). Only new construction of residential buildings is the exception to Virginia adopting the current IECC standard. When the residential energy efficiency standards were weakened in 2012, it broke from the Commonwealth's past practice of adopting IECC standards for commercial and residential construction. It is time for the Board to make Virginia's commercial and residential codes consistent with international standards.

Section 36-99A of the Virginia Code clearly states: "*The provisions of the Building Code and modifications thereof shall be such as to protect the health, safety and welfare of the residents of the Commonwealth, provided that buildings and structures should be permitted to be constructed, rehabilitated and maintained at the least possible cost consistent with recognized standards of health, safety, energy conservation and water conservation…*." Section 36-99B further states: *"[T]he Board shall have due regard for generally accepted standards as recommended by nationally recognized organizations, including, but not limited to, the standards of the International Code Council…."*

Those current residential USBC energy efficiency standards are nearly 10 years behind international standards. The Commonwealth is behind the building codes of Maryland, DC and 26 other states. The weak USBC energy efficiency standards increase operating costs for homebuyers and renters, jeopardize the health and safety of Virginians, needlessly squander energy and increase greenhouse gas emissions. The US Department of Energy found that the IECC standards upgraded from 2009 (Virginia's current USBC) to 2012 would be cash positive for new homebuyers from the first month of occupation.

Improving the energy efficiency of Virginia's housing stock supports the Commonwealth's energy policy and law. Governor Northam's Executive Order Forty-Three explicitly recognizes that *"energy efficiency programs are the lowest cost energy option, producing electricity cost savings, creating jobs and revenue from the energy efficiency service sector, and helping to reduce greenhouse gases and other air pollutants. Virginia has a statewide goal of reducing retail electricity consumption by ten percent by 2022 using 2006 as a baseline. These reductions will come from a combination of sources, **including building codes**, energy performance contracting, private financing programs, and investments from the Commonwealth's utilities*."

The Virginia Clean Energy Act (House Bill 1526 and Senate Bill 851) declares energy efficiency programs to be "in the public interest." It requires the Department of Social Services and the Department of Housing and Community Development to convene stakeholders to develop recommendations to implement a program to reduce the energy burden for low-income Virginians. The Clean Energy and Community Flood Preparedness Act (House Bill 981 and Senate Bill 1027) established a carbon dioxide cap-and-trade program to reduce emissions from power plants. Half of the estimated $150 million annual carbon auction revenue is designated for low income energy efficiency. Section 36-99.01 of the Virginia Code recognizes the *"urgent need to improve the housing conditions of low- and moderate-income individuals and families [and] to improve the existing condition of many of the Commonwealth's stock of commercial properties.*" Clearly, the Governor and legislature have set clear direction – energy efficiency of Virginia's residential housing is a statutory priority.

Increased residential building efficiency will help alleviate energy poverty in the Commonwealth. The Governor's Executive Order 43 notes: "*Low-income households pay proportionately more than the average household for energy costs and often experience negative long-term effects on their health and welfare*." The Governor directed DMME to work with the Virginia Department of Housing and Community Development "*to include complementary policy options, such as developing and administering energy financing programs and* ***enhancing building codes****.*" An ACEEE study found that half of low-income Richmond households spend more than 6.5% of their income on energy, one-quarter spend over 11.5%. Rates of energy poverty are even higher in Virginia Beach. Rigorous energy codes like the 2018 International Energy Conservation Code (IECC) benefit these families tremendously by helping

Increased energy efficiency does increase initial construction costs, but it produces savings for residents over building lifetimes. In 2015, A 2015 Virginia Tech Center for Housing Research study of Earthcraft-certified affordable rental housing in Virginia found their energy use was about 30 percent less than in similar homes built to Virginia's USBC. Residents saved $54 per month. A 2017 update found residents annual energy costs were 45% below comparable housing built to the Virginia codes. The US Department of Energy estimated that added residential construction costs for a 2,400 square foot house to comply with the 2012 IECC were $2,138 more than the 2009 code. The median new home in Virginia in May 2020 sold for $291,002. Complying with current IECC standards would add 0.7% to the new home price.

Annual energy savings from efficiency upgrades are $388. In only 5.5 years, a homeowner would recoup the added construction costs. Life-cycle cost savings, averaged across building types, are $5,836 for the 2012 IECC. A large Virginia homebuilder estimates that the added insulation costs to meet 2018 IECC standards for walls would be $399 and $215 for ceilings. Savings would be in the range of $78-$103/year for improved wall insulation and $10-14/year for improved ceiling insulation. The 2018 IECC standards for fenestration and slab insulation are slightly higher than Virginia's USBC. The IECC standard for sealing the building envelop is an air leakage rate no higher than 3 ACH at 0.2-inch w.g. (50 Pascals) in climate zone 4. IECC tightened air-change rates in the 2012 update from less than 7 ACH to less than or equal to 3 ACH @ 50 pascals.

The effect of this code change proposal will be an improvement in the energy efficiency of residential buildings by 5% or more. It will provide builders with standards that are already mandated by the majority of states. This proposal recommends Virginia's residential building energy efficiency codes mirror the Commonwealth's commercial building codes.

New residential construction is the exception to Virginia's requirements that buildings comply with the IECC energy requirements. For example, Virginia's code for renovation of existing residential buildings already mandates compliance with the IECC. Sections 601.4 and 602.3.4 require all new work to conform to the energy requirements of the IECC. The IECC standards for multi-unit dwellings (R403.8) require compliance with Sections C403 and C404 of the commercial provisions. In each of these instances, Virginia's code for new residential construction is out of step with its standards for every other type of building.

BHCD could be more forward in its standards by adopting Maryland's process. Maryland Chapter 294 mandates adoption of the newest IECC standard within 12 months after it is issued. By statute, Maryland's Department of Housing and Community Development "*may adopt energy conservation requirements that are more stringent than the requirements in the International Energy Conservation Code, but may not adopt energy conservation requirements that are less stringent than the requirements in the International Energy Conservation Code."* Local jurisdictions are required to implement and enforce the most current version of the standards. Were the BHCD to simply accept the most current IECC, it would help meet the Governor's Executive Order Forty-three, the Virginia Clean Economy Act and the Clean Energy and Community Flood Preparedness Act. It would save residents' money and cut greenhouse gases.

Conclusion

In summary, we strongly urge the BHCD to adopt final rules for a revised residential building code that contains all of the provisions of the 2018 IECC for new construction and for rehabilitation of existing buildings. We recommend the Board adopt a policy similar to Maryland's which requires adoption of the new IECC standards within 12 months of their publication.

Respectfully submitted,

Eric Goplerud
Board Chair, Faith Alliance for Climate Solutions

Testimony before the Board of Housing and Community Development in support of improved energy efficiency standards for new residential construction

Eric Goplerud
Board Chair, Faith Alliance for Climate Solutions
June 26, 2020

The Faith Alliance for Climate Solutions is a nonpartisan interfaith organization of more than 75 faith communities and 2,400 faith-based activists in Northern Virginia. We recommend adoption of the 2018 IECC without exception for new residential construction. Residences consume 25% of the state's total energy. Many states, including Maryland, DC and North Carolina have more rigorous residential energy efficiency standards than ours. The ACEEE ranks us 29th, below even Florida, Texas and Nevada.

We urge you adopt these changes:

1. Meet or exceed 2018 IECC standards for floor, wall, ceiling and fenestration insulation.
2. Limit air infiltration to 3 air changes per hour or less, the IECC standard since 2012.
3. As standards are strengthened, the Board should emulate Maryland, which requires new IECC standards be adopted within 12 months of their publication.

The Governor's Executive Order Forty-Three directs DHCD "to enhance building codes." The Virginia Clean Energy Act directs DHCD to reduce the energy burden on low-income Virginians. Half of revenues generated by RGGI auctions must be devoted to low income energy efficiency. The Governor and legislature want improved residential energy efficiency.

Meeting the current IECC standards would add 0.7% to the new home prices in Virginia. Homeowners would recoup that within 5.5 years.

The Board already adopts the current IECC standards for new commercial construction, multi-unit dwellings and renovations of existing commercial and residential buildings. Only new residential construction is the exception. It is time for the Board to make Virginia's commercial and residential codes consistent with international standards.

LAURA FRYE • DHI • Door Security + Safety Professionals • 2025 M Street N.W., Suite 800 • Washington, D.C. 20037
C: 765-605-1270 • lfrye@dhi.org

June, 26, 2020

Ms. Cindy Davis
Deputy Director of Building and Fire Regulations
Department of Housing and Community Development

My name is Laura Frye with the Door & Hardware Institute, I was a member of the School Safety Subworkgroup that was convened to examine locking devices, barricade devices, and other safety measures that might be utilized during an active shooter or hostile threat situation.

I was asked to be a member of the group as an Industry expert with over 30-years experience in the door security and safety industry.

I sit on various fire and life safety code and standard development technical committees including NFPA 3000 which is the Active Shooter and Hostile Event Response Standard.

We look at barricade devices only as a solution and do not consider that barricading has been used to commit school violence.

There are documented cases of "Barricaded Captive Situations in School" that we are not considering. There was a study done of 19 such incidents, of the 19 events, 16 were carried out by students. In one incident, Platte Canyon HS, seven female captives were sexually assaulted by the subject. Explosives were used by emergency responders in order to gain access to the classroom, and a student hostage was killed by the shooter during the chaos.

In another incident, the West Nicklel Mines School, an Amish Schoolhouse, multiple captives were shot by the subject: Five were injured and five were killed before the subject was killed. After the West Nickel Mines shooting several news reports discussed law enforcement officers' concerns that they are not equipped to overcome classroom barricades.

The barricade study suggests there are roughly two barricaded captive situations in schools each year in the United States (this is without providing the devices at the door for perpetrators to use). Whether the situation ends peacefully or in losses due to injuries or fatalities, multiple victims are traumatized by the unpredictability and loss of control that characterize these events.

LAURA FRYE • DHI • Door Security + Safety Professionals • 2025 M Street N.W., Suite 800 • Washington, D.C. 20037
C: 765-605-1270 • lfrye@dhi.org

Allowing these devices creates a breeding ground for this type of incident.

A few items in the proposed language cause me great concern. In this language, the use of barricade devices are not limited to classroom doors. The code allows for these devices on "exit access doors from classrooms, offices and other occupied rooms". In addition, the code does not prohibit the use of these devices on doors with panic or exit hardware. Driven by code, rooms with high occupancy require the use of these type devices. These proposals would allow the use of barricade devices on doors like gymnasiums, libraries or auditoriums. Assailants looking to do harm could potentially walk into a Middle School band performance lock multiple doors and cause mass casualties to a room filled with people who have no possibility of escape.

Introducing the use of barricade devices attempts to fix a problem we do not have, locks not being strong enough, but does not address ones we know we have, like the vulnerability of glass. We have had school shootings where a perpetrators access was gained primarily through the failure of glass. Barricade devices do nothing to remedy that known weakness, they just serve to give us false confidence that the room or building is protected. I don't believe either proposal submitted will increase the safety in any school and more than likely will introduce new and greater hazard to occupants.

I am a Virginia resident and advocate on the behalf of the Door and Hardware Institute representing over 3,000 door + security and safety professionals in the US. I would ask that you not allow the use of barricade devices on schools or any other public building.

Sincerely,

Laura Frye

Laura Frye, DHT, AHC, DHC, CSI, CDT, CCS, FDAI
Door and Hardware Institute
Director of Education and Certification

DHCD Public Comment
June 26, 2020

Do not modify the Virginia Construction Code to permit barricade devices.

The Virginia 2019 Uncodified Acts, Chapter 723 (SB 1755, 2019 Session) required examination of various safety and security measures to utilize in the event of an active shooter or hostile threat, but did not mandate barricade devices nor changes to the Virginia Construction Code.

There is a fundamental building code mandate to assure life and fire safety for building occupants. Life and fire safety of the building occupants is assured by providing free and unobstructed egress from a building, and from all occupied spaces within a building. Barricade devices that are not readily openable from the egress side without the use of a key or special knowledge or effort are contrary to this fundamental mandate.

Locking door hardware (i.e., classroom lock function) provides a building code compliant and secure method to prevent unauthorized access while maintaining free egress. There are barricade devices that do not allow free egress. In the case of an emergency, such barricade devices may impede egress or emergency access. In the event of a fire, a barricade device could impede egress, and in the event of an active shooter or hostile threat a barricade device could be used by the assailant to keep occupants in a building. Both of these examples could result in a greater life and fire safety risks than may occur with standard locking door hardware.

Standard door hardware provides a code compliant, tested and safe method to assure physical security. Alternate physical and operational security measures should be established to supplement door hardware compliant with the Virginia Construction Code.

Related:

No standard locks have been breached by shooters.

Alternative security in the form of a Secure Site Perimeter, Operational Policies including screening and normally closed and locked doors, Police Presence and Segregation of Building Areas can provide security without compromising life and fire safety.

Public is reactionary and uninformed of the relationship of the many and varied life and fire safety concepts in the building code.

Lifetime odds of a person being killed:

63 times more likely to die from fire and smoke than a terrorist attack.
908 times more likely to die in a motor vehicle accident than a terrorist attack.

Allowing barricade devices that impede egress in a building poses life and fire safety risks that don't exist now, and result in a direct contradiction of the intent of internationally recognized consensus life and fire safety concepts. Do not modify the Virginia Construction Code to permit barricade devices that impeded building egress.

Commonwealth of Virginia

Flanders, Kyle <kyle.flanders@dhcd.virginia.gov>

Amendments to USBC 115.2

Sharp, David V. <David.Sharp@fairfaxcounty.gov> Fri, Jun 26, 2020 at 11:29 AM
To: "kyle.flanders@dhcd.virginia.gov" <kyle.flanders@dhcd.virginia.gov>

Mr. Flanders,

I have submitted a comment through the townhall website. However I just heard the Chairman announce that you were taking comments through email, and I wanted to be certain to register my comments with respect to the above referenced amendments. I am submitting these comments as a private individual, but it bears mentioning that I have taught on this very issue for over a decade for the Virginia Building Code Academy.

The package concerning 13VAC5-63-100 states that this amendment would result in "adding a provision that the notice of violation can be issued to other persons deemed responsible in addition to the person performing the work." However, the opposite is achieved by this amendment through the imperative language to issue to the permit holder (who may not be responsible for the work), the removal of the terminology "Responsible Party," and the addition of permissive language to *allow* the issuance to other parties found to be responsible.

The changes to Section 115.2 to remove the "Responsible Party" are on dangerous legal ground.

First, one must recognize that according to Section 115.1, violation of the Building Code is a criminal offense (non-classed misdemeanor). "In accordance with § 36-106 of the Code of Virginia, it shall be unlawful for any owner or any other person, firm or corporation, on or after the effective date of any code provisions, to violate any such provisions." Further, the Code intentionally employs language specifying that it is unlawful for "any person, firm or corporation to violate the code." This purpose of this language to eliminate the possibility of a loophole for that would otherwise allow for work without a permit or work performed by contractors without a license where the code official would only have the option to charge the property owner with a criminal act.

Second, this change ignores the requirements set forth in 112.1 which states in relevant part: “It shall be the duty of *any* person performing work covered by this code to comply with all applicable provisions of this code and to perform and complete such work so as to secure the results intended by the USBC.” This language places a legal duty on the individual performing the work to comply with the Code and is intentionally worded in such a way that one cannot claim that they are not legally responsible simply because they are not the name listed on the permit. It is Section 112.1 that establishes for the code enforcement official exactly who the responsible party is.

By removing the requirement to issue the Notice of Violation to the “Responsible Party” you get 2 very negative outcomes. First, this would result in issuing what amounts to a criminal citation to a property owner simply because an unlicensed contractor duped them into obtaining the permit in their name. This is the legal equivalent of the police issuing a citation to the victim of a robbery simply because they failed to lock their door. Second, the real “criminal” (i.e. the unlicensed contractor or the contractor who inappropriately failed to obtain a required permit) gets away with the criminal act because this change would redefine legal responsibility to the victim of the criminal act. Furthermore, simply allowing for the issuance of a Notice of Violation to other parties through permissive language while directing the issuance of the notice to the permit holder ignores our responsibility as code enforcement officials to hold those performing the work accountable for proper, code compliant construction.

To illustrate the potential for serious legal implications, I will share an example from a locality that occurred when the NOV was incorrectly issued to a homeowner rather than the “Responsible Party.” The property owner was told by the “contractor” that if he obtained the permit, it would be cheaper and easier, as the County was more forgiving of homeowners than contractors. The unsuspecting owner obtained the permit in his name listing “Owner as Contractor” on the issued permit. The contractor was not properly licensed for the scope of work to be performed. There were numerous problems with the work that eventually led to the issuance of a NOV. The NOV was improperly issued to the homeowner, even though he was not the one performing the work and creating the violation condition. Meanwhile, the real violator was not cited and eventually simply walked off the job with money in hand and no legal ramifications. All that was bad enough, but it gets worse. The owner held a high-level security clearance with the Federal Government which was put at risk due to the improperly issued citation. The unlicensed contractor, because no legal action was brought against him, was free to continue to victimize other unsuspecting property owners without consequence.

Finally, Code already recognizes that the ultimate purpose of the correction and Notice of Violation process is to achieve compliance with the Code – even when we are no longer able to pursue the "Responsible Party" to that end and provides a mechanism for citing additional parties. Section 115.2 contains language differentiating to whom the NOV is to be issued, and who is to be copied. That is precisely why Section 115.2 contains the statement: "When the owner of the building or structure, or the permit holder for the construction in question, or the tenants of such building or structure, are not the responsible party to whom the notice of violation is issued, then a copy of the notice shall also be delivered to the such owner, permit holder or tenants." Note the clear distinction provided between thee party responsible for creating the violation ("Responsible Party") and other parties who may ultimately be brought into the process as responsible for compliance should the code enforcement official be unable to pursue legal remedies with the "Responsible Party." Code officials already have the ability to issue notices to additional parties without weakening the legal position as it currently is defined. This portion of the process insures that the property owner/tenant (permit holder) is aware of the situation and provides a path forward to compliance should the real criminal (the Responsible Party) disappear.

It is critical to the proper enforcement of Code that we, as code officials, are diligent in pursuing the "Responsible Party." This change does not help to promote that end. In fact, it does quite the opposite, and weakens our enforcement position in the long run, as any half-decent attorney would chew up any case brought before a judge that charged anyone other than the party responsible for the criminal act. I urge you to maintain the strong legal support for the issuance of citations to those who create the violation condition by rejecting this amendment.

Sincerely,

David V. Sharp

Code Academy Manager

Fairfax County Land Development Services

Commonwealth of Virginia

Flanders, Kyle <kyle.flanders@dhcd.virginia.gov>

Comment to BHCD for June 26, 2020 meeting, re the uniform statewide building code for new residential construction

Environment <environment@fallschurchva.gov> Fri, Jun 26, 2020 at 6:08 AM
To: "kyle.flanders@dhcd.virginia.gov" <kyle.flanders@dhcd.virginia.gov>

The City of Falls Church's Energy Transition Subcommittee (ETS) urges the Board of Housing and Community Development (BHCD) to fully adopt the 2018 IECC model code for residential construction, as part of its update of the state's USBC. The current proposal before the BHCD contains amendments that would leave Virginia's USBC deficient in the areas of insulation and measured air changes, and should be modified to conform to the 2018 IECC with respect to energy efficiency.

The ETS is a subcommittee of the City of Falls Church's Environmental Sustainability Council, whose members are appointed by the Falls Church City Council.

The City of Falls Church has adopted by City Council resolution a goal of reducing city-wide greenhouse gas emissions 80% below 2005 levels by 2050. Since buildings are responsible for the largest portion of these emissions, it is important to reduce emissions from this sector. Improving the energy efficiency of new residential buildings will help the City achieve its emissions goal, as well as improving the sustainability and resilience of homes in the City. The City is nearing completion of a new high school that has been designed with an Energy Use Intensity of 22, leading by example in areas where it has authority.

Since the City relies on the Virginia USBC for residential construction designs, it is important that the state take reasonable steps to improve the energy efficiency of new buildings. Adopting the 2018 IECC energy efficiency guidelines is a reasonable action, since representatives from jurisdictions throughout Virginia participated in developing the 2018 IECC model code. Allowing one stakeholder group - a trade association for new residential construction – to influence the adoption of a USBC that is weaker than the 2018 IECC with respect to residential construction energy efficiency designs is not a reasonable action. A number of other states have already adopted the 2018 IECC in entirety and Virginia should do the same.

Tim Stevens

Chair Energy Transition Subcommittee

City of Falls Church

Commonwealth of Virginia

Flanders, Kyle <kyle.flanders@dhcd.virginia.gov>

Comments for the BHCD building code public hearing

Susan Stillman <stillman.susan@gmail.com> Fri, Jun 26, 2020 at 2:14 PM
To: "Flanders, Kyle" <kyle.flanders@dhcd.virginia.gov>

I tried to participate in this morning's call but the technology wasn't working properly. Below are my comments that I would like to have entered into the record.

TO: Members of the BHCD

Virginians should be able to know that when they invest in a new home or have a home renovated that it is energy efficient. A home is an investment with monthly mortgage costs. When a home is not well built there is the additional burden of high heating and cooling bills. These bills, just like the mortgage must be paid every month for the life of the home. Building in efficiency up front is much less expensive than retrofitting later.

To mitigate high utility bills Virginia's building code should meet or exceed 2018 IECC energy conservation standards for all forms of construction covered by the USBC.

The BHCD should require builders to meet the full 2018 IECC standards for envelope efficiency – particularly walls and ceilings – not extend outdated 2009 standards that were superseded by the IECC in 2012.
The code should require builders to conduct a blower door test and to limit air infiltration to 3 air changes per hour, which has been the required since the 2012 IECC.

The home I grew up in was built in the 60's when there was a moratorium on new homes with natural gas. The home was very well built but it had resistance heat. My mother's electric bills were very high even though she only heated the room she was in. Virginia should require the installation of modern heat pumps and "mini-splits" and prohibit installation of electric resistance heating (e.g., electric furnace or baseboard heating).

Studies have shown that children raised in a home with natural gas cooking have a 48% higher rate of asthma. Homes should be set up to be ready to shift all electric. We have the technology now with heat pumps and induction cooking to make all electric homes safe, comfortable and affordable. Electric hot water heating with heat pump technology is very efficient.

Rehabilitated homes should have to meet the 2018 requirements as well. Renovating a home is expensive and homeowners should get the reduced energy bills affiliated with a well renovated home.

Homes of all types should solar ready and be wired for electric vehicle charging. I just had a 220 line run in my home. It was expensive to do in an existing dwelling and there are now many places where drywall has to be patched and painted. Installing an additional 240 line when a home is built is cost effective.

Sincerely,
Susan L. Stillman
213 Ayr Hill Ave NE
Vienna, VA 22180

Commonwealth of Virginia

Flanders, Kyle <kyle.flanders@dhcd.virginia.gov>

Hultstrom Public Comment to Virginia Register of Regulations VOL 36 ISS 12 13VAC5-63-60 Section 110.8 Permits

1 message

Scott Hultstrom <SHultstrom@eiwpf.org> Tue, Mar 31, 2020 at 1:54 PM
To: "kyle.flanders@dhcd.virginia.gov" <kyle.flanders@dhcd.virginia.gov>

Greetings,

I am submitting this comment for use in your proposed changes to 13VAC5-63-60. Section 110.8 Permits, as seen in the attached document.

I agree with and fully support the revision in Section 110.8 stating "…as required by Section 110.7, noncompliance with provisions of this code and pertinent laws and ordinances, or incorrect…"

Rationale: In a code enforcement scenario it is important to indicate and use a given code and pertinent laws and ordinances as the concept of "codes are not laws but are enforced under laws" governs the seriousness and gravity of any given scenario. Great job.

Please confirm this public comment has successfully been submitted.

R. Scott Hultstrom

IUEC Member

6919 South Valley Stream Drive

Tucson, Arizona 85757 USA

Cell: +1 520-300-1039

Virginia Register of Regulations VOL. 36 ISS. 12.pdf
3862K

Commonwealth of Virginia Mail

Flanders, Kyle <kyle.flanders@dhcd.virginia.gov>

Hultstrom Public Comment to Virginia Register of Regulations VOL. 36 ISS. 12, 13VAC5-63-50, Section 105 Technical assistant

1 message

Scott Hultstrom <SHultstrom@eiwpf.org> Thu, Mar 26, 2020 at 12:47 PM
To: "kyle.flanders@dhcd.virginia.gov" <kyle.flanders@dhcd.virginia.gov>

Greetings,

I am submitting this comment for use in your proposed changes to 13VAC5-63-50 as seen in the attached document.

Section 105 Technical assistant, **revise** as follows:

F. Section 105.2.1 Qualifications of technical assistants. A technical assistant shall provide documentation verifying completion of specific training in an area they are being considered to be a technical assistant and have at least three years of experience and general knowledge in at least one of the following areas specific to the area they will work in: building construction; building construction conceptual and administrative processes; building, fire or housing inspections; plumbing, electrical or mechanical trades; or fire protection, elevator or property maintenance work. Any combination of education and experience that would confer equivalent knowledge and ability~~, including high school technical training programs or college engineering, architecture, or construction degree programs,~~ shall be deemed to satisfy this requirement. The locality may establish additional qualification requirements.

Rationale: Allowing qualifications to be established via high school training lowers the safety provided. Enforcement of codes and standards should be by individuals who are both trained and possess experience practically applying any given area of effort so as to ensure safety to life, limb and to promote the welfare of communities served.

Please confirm this public comment has successfully been submitted.

R. Scott Hultstrom

IUEC Member

6919 South Valley Stream Drive

Tucson, Arizona 85757 USA

Cell: +1 520-300-1039

Virginia Register of Regulations VOL. 36 ISS. 12.pdf
3862K

Commonwealth of Virginia

Flanders, Kyle <kyle.flanders@dhcd.virginia.gov>

Hultstrom Public Comment to Virginia Register of Regulations VOL. 36 ISS. 12, 13VAC5-63-60. Section 106 Powers and duties of the building official

1 message

Scott Hultstrom <SHultstrom@eiwpf.org> Thu, Mar 26, 2020 at 4:56 PM
To: "kyle.flanders@dhcd.virginia.gov" <kyle.flanders@dhcd.virginia.gov>

Greetings,

I am submitting this comment for use in your proposed changes to 13VAC5-63-60. Section 106 Powers and duties of the building official, as seen in the attached document.

Comment regarding 13VAC5-63-60. Section 106 Powers and duties of the building official. Please revise as follows:

D. Section 106.3.1 Substantiation of modification. The building official may require or may consider a statement from ~~an RDP~~ a registered design professional (RDP) or other person competent in the subject area of the application as to the equivalency of the proposed modification. In addition, the building official may require the application to include construction documents sealed by an RDP. ~~The building official may also consider nationally recognized guidelines in deciding whether to approve a modification.~~

Rationale: I agree with the clarification of "RDP" but the last sentence is questionable and I object. Allowing any building official or enforcer of codes and standards to consider nationally recognized guidelines in deciding whether to approve a modification lowers the safety provided as written in the proposal. Enforcement of codes and standards should be derived from a finite list of codes and standards as enforced by laws, statutes and ordinances as applicable so as to ensure safety to life, limb and to promote the welfare of communities served. If you were to allow the consideration of various standards, codes etc. please establish a finite list as seen for example as used by ASME A17.1, Section 9.1 where there is a somewhat vetted list established. Considerations need to be specific. There is some trend toward ISO standards so a word about them is in order. Please understand that ISO standards are not safety standards, but rather marketing standards designed to increase business globally. At least two significant entities advertising to be leaders in the transportation industry improving safety codes, developing safer products and educating the public on safe riding practices have indicated two conflicting positions on this topic, the

point being that the dominant code developing balance of interest has not made up its mind in this area, therefore warranting your scrutiny.

Develop a closed list rather than leaving an ambiguous option here. If any assistance or resources are desired feel free to contact me and I will gladly assist as best I can. I can provide detailed technical assistance as requested.

Please confirm this public comment has successfully been submitted.

R. Scott Hultstrom

IUEC Member

6919 South Valley Stream Drive

Tucson, Arizona 85757 USA

Cell: +1 520-300-1039

Virginia Register of Regulations VOL. 36 ISS. 12.pdf
3862K

Commonwealth of Virginia

Flanders, Kyle <kyle.flanders@dhcd.virginia.gov>

Hultstrom Public Comment to Virginia Register of Regulations VOL. 36 ISS. 12, 13VAC5-63-200. Chapter 2 Definitions

1 message

Scott Hultstrom <SHultstrom@eiwpf.org> Thu, Mar 26, 2020 at 1:47 PM
To: "kyle.flanders@dhcd.virginia.gov" <kyle.flanders@dhcd.virginia.gov>

Greetings,

I am submitting this comment for use in your proposed changes to 13VAC5-63-200. Chapter 2 Definitions as seen in the attached document.

Comment regarding 13VAC5-63-200:

My comment is regarding the addition of the definition of emergency supplemental hardware which I commend you all on making effort in this area. Please make sure to vet this new feature fully so as to address not negatively affecting areas such as exit, egress and accessibility as codified under but not limited to IBC, VA USBC, IFC and OSHA regulations. Furthermore there are efforts being made in this area as it affects elevators and related conveyances. If any assistance or resources are desired feel free to contact me and I will gladly assist as best I can. I can provide detailed technical factors that need be vetted.

Rationale: Providing engineering controls to mitigate hazards associated with active shooter etc. are clearly in order and well received. Enforcement of this plan through codes and standards increases the safety to life, limb and to promotion the welfare of communities served.

Please confirm this public comment has successfully been submitted.

R. Scott Hultstrom

IUEC Member

6919 South Valley Stream Drive

Tucson, Arizona 85757 USA

Cell: +1 520-300-1039

Virginia Register of Regulations VOL. 36 ISS. 12.pdf
3862K

Commonwealth of Virginia

Flanders, Kyle <kyle.flanders@dhcd.virginia.gov>

Hultstrom Public Comment to Virginia Register of Regulations VOL. 36 ISS. 12, 113VAC5-63-80, Section 108 Application for permit

1 message

Scott Hultstrom <SHultstrom@eiwpf.org> Thu, Mar 26, 2020 at 8:39 PM
To: "kyle.flanders@dhcd.virginia.gov" <kyle.flanders@dhcd.virginia.gov>

Greetings,

I am submitting this comment for use in your proposed changes to 13VAC5-63-80, Section 108 Application for permit, as seen in the attached document.

Comment regarding 13VAC5-63-80, Section 108 Application for permit. Please revise as follows:

D. Section 108.4 Prerequisites to obtaining permit. In accordance with § 54.1-1111 of the Code of Virginia, any person applying to the building department for the construction, removal or improvement of any structure shall furnish prior to the issuance of the permit either (i)

satisfactory proof to the building official that he is duly licensed or certified under the terms or Chapter 11 (§ 54.1-1000 et seq.) of Title 54.1 of the Code of Virginia to carry out or superintend the same or (ii) file a written statement, supported by an affidavit, that he is not subject to licensure or certification as a contractor or subcontractor pursuant to Chapter 11 of Title 54.1 of the Code of Virginia.

The supporting affidavit shall bear:

- a title that it is an affidavit
- the name of the affiant applying for the permit
- the names of any other necessary parties involved whom may act as the representative of the affiant if any
- the affirmation "In accordance with 13VAC-63-80, Section 108D, I **[Affiant's Name]** am attesting that I am not subject to licensure or certification as a contractor or subcontractor pursuant to Chapter 11 of Title 54.1 of the Code of Virginia. I further attest I fully understand the conditions of this document and the required compliances referenced and that any and all information I provide as requested is true."

- A statement that any failure on the affiant to provide accurate truthful compliance with this affidavit and its conditions subjects them to conditions of but limited to penalty of perjury, fine, and/or imprisonment.
- Indication of any additional supporting documents (additional supporting documents shall be organized, labelled by letter (Exhibit A, Exhibit B, etc.) and referenced in an affidavit by label when necessary and attached to the final physical affidavit document or integral to an electronic document in the form of a PDF if allowed.
- A section titled certification which shall be completed in the presence of a notary and possess
  - the affiant's signature of their legal name
  - the date of signing the affidavit
  - the signature, date of signing, printed legal name and signature of one or more witnesses
  - the signature, date of signing, printed legal name and signature of the notary
  - the notary's stamp
  - the notary's state issued notary ID number

The applicant shall also furnish satisfactory proof that the taxes or license fees required by any county, city, or town have been paid so as to be qualified to bid upon or contract for the work for which the permit has been applied.

Rationale: As a licensed state and with the potential the jurisdictions business plan does not provide for every oversight then please do not weaken the ability for the jurisdiction to ensure safety to life, limb and to promote the welfare of communities served. An affidavit has the ability to impose the seriousness of a given scenario on all parties involved so as to make no mistake that all work done in the jurisdiction albeit licensed or otherwise is done so with quality and safety. It further may need elements of what to do if in fact an affidavit is being submitted that indicates a conflict where an applicant is or is applying regarding a scenario indicating no need to be licensed but in fact the work is under a licensed scope. Furthermore in the event any of this is being used for any residence occupancy classification where it may affect persons with disabilities, there are legal precedents set requiring oversight by the State of Virginia and its jurisdictions.

Keep the affidavit, just define its terms and purpose in detail. If any assistance or resources are desired feel free to contact me and I will gladly assist as best I can. I can provide detailed technical assistance as requested.

Please confirm this public comment has successfully been submitted.

R. Scott Hultstrom

IUEC Member

6919 South Valley Stream Drive

Tucson, Arizona 85757 USA

Cell: +1 520-300-1039

Virginia Register of Regulations VOL. 36 ISS. 12.pdf
3862K

June 26, 2020

2105 M Street
Richmond, VA 23223
804.401.9236
wshepherd@nrdc.org

Mr. Kyle Flanders
DCHD
Ste 300
600 East Main Street
Richmond, VA 23219

RE: Building Code Update

Dear Mr. Flanders,

On behalf of NRDC (Natural Resources Defense Council) and our over 9,500 paying members in Virginia, we submit the following comments on the proposal to update the energy provisions of Virginia's Uniform Statewide Building Code (USBC).

This an important and long-lasting opportunity for the Board to protect the economic well-being of Virginians for generations to come. Just as impactful, buildings are responsible for about 40 percent of all carbon emissions in the US, and the buildings constructed today will be in use for 50 to 100 years, or more. Constructing efficient buildings from the start will yield energy and cost savings over the entire lifetime of the building, while ensuring greater levels of comfort and safety for inhabitants.

Virginia has recognized the need to act to avoid the most costly impacts of climate change, recently passing the Virginia Clean Economy Act and joining the Regional Greenhouse Gas Initiative to reduce carbon pollution from the power sector. A strong, robust, continually-improving building energy code is a crucial policy tool that is fully consistent with the Commonwealth's carbon reduction goals. In fact, it will be impossible to achieve meaningful climate goals *without* addressing the energy consumption of buildings. Improving building energy efficiency is one of the best and most cost-effective tools we have to reduce the effects of climate change, while keeping people more comfortable and lowering energy bills.

NRDC fully supports Virginia's efforts to update the energy provisions of the USBC. We encourage clean adoption of the 2018 International Energy Conservation Code (IECC), with strengthening amendments as described below.

Commonwealth of Virginia
Before The
Board of Housing and Community Development

COMMENTS ON PROPOSED AMENDMENTS TO THE UNIFORM STATEWIDE BUILDING CODE OF THE VIRGINIA CHAPTER OF THE SIERRA CLUB, FAITH ALLIANCE FOR CLIMATE SOLUTIONS, CLIMATE ACTION ALLIANCE OF THE VALLEY

The Virginia Chapter of the Sierra Club, Faith Alliance for Climate Solutions, Climate Action Alliance of the Valley hereby comment on the pending proposal to update Virginia's Uniform Statewide Building Code (USBC).

STATEMENT OF INTEREST

These comments are submitted by the Virginia Chapter of the Sierra Club, Faith Alliance for Climate Solutions and Climate Action Alliance of the Valley. Each of these organizations has members who reside in Virginia and whose dwellings, health, welfare and energy costs may be affected by the outcome of these proceedings. Particularly, now that climate change is bearing down on Virginia's residents, environment and economy, it is more critical than ever that Virginia's building codes maximize energy efficiency in new and rehabilitated buildings, both residential and commercial. In addition to minimizing energy consumption, it is also important that buildings be designed, from the outset, to accommodate new carbon reducing technologies, including rooftop solar and electric vehicles.

More detailed descriptions of these organizations are attached as Appendix A.

SUMMARY OF RECOMMENDATIONS

We urge the BHCD to adopt the following changes to the energy and other provisions of the USBC:

- **Meet or exceed 2018 IECC energy conservation standards for all forms of construction covered by the USBC.** Virginia's USBC has lagged behind the energy conservation requirements of the IECC since at least 2012. However, there is nothing unique about Virginia, its residents or the capabilities of its builders which would justify adoption of any standards that would yield less energy efficiency than the 2018 IECC prescribes for new and existing buildings. To the contrary, meeting or exceeding the 2018 IECC is required to meet the needs of, and growing challenges to, Virginia's residents and economy.

- **Among other measures relevant to residential construction of new residential buildings, the BHCD should**
    - Require builders to meet the full 2018 IECC standards for envelope efficiency – particularly walls and ceilings – not extend outdated 2009 standards that were superseded by the IECC in 2012;
    - Require builders to conduct blower door test and to limit air infiltration to, at most, 3 air changes per hour, which has been the required envelope tightness measure since the 2012 IECC;
    - Require builders of new homes to implement all the efficiency standards in the IECC, plus implement an additional measure chosen from several additional measures (identified below) which would improve energy efficiency of the structure by 5-10% beyond the efficiency required by the 2018 IECC;
    - Prohibit installation of electric resistance heating (*e.g.*, electric furnace or baseboard heating) which is highly inefficient compared to modern heat pumps and "mini-splits".
    - Require electric readiness for shifting, in the future, to all-electric air and water heating.
    - Adopt a zero-energy option for builders, which would allow them to advertise a net-zero energy dwelling if implemented and which would provide a more uniform set of net-zero-energy provisions that could be applied across the Commonwealth.

- **Meet and exceed 2018 energy efficiency standards for rehabilitation of existing residential and commercial buildings.** Virginia Code Section 36-99.01 recognizes the "urgent need to improve the housing conditions of low and moderate income individuals and families [and] to improve the existing condition of many of the Commonwealth's stock of commercial properties." Although it expresses concern that rehabilitation costs have "sometimes" been raised by building codes, nothing in that section suggests that the BHCD should weaken or eliminate energy efficiency standards that will reduce renters' and buyers' energy costs, reduce pollution for the benefit of all Virginians. Tenants and buyers, particularly low and moderate income residents, are disserved by high energy bills attributable to inefficient dwellings. In addition to deep energy retrofits during rehabilitation projects, there are also opportunities to save energy every time a building is renovated. The 2018 IECC requires additions and new building materials used in alterations to meet the same level of efficiency as in new buildings, and it requires buildings undergoing a change in occupancy usage to meet reasonable efficiency requirements as well. Energy saving measures should be required with all renovations to the extent required by the 2018 IECC unless the property owner can demonstrate a better way to achieve equivalent reductions of energy costs.

- **Regardless of whether it is in the energy section or in another section of the USBC, new single and multifamily dwellings should be**

- **Required to incorporate electric vehicle charging capabilities and readiness in garages, carports and outdoor parking for single and multifamily construction;**
- **Required, to the extent possible, to incorporate or at least be oriented and pre-wired to add on-building solar energy in the future.**

Code Process. We also urge the BHCD to change its process for approving USBC updates. It should establish a clear policy that all energy efficiency improvements prescribed by new IECC standards shall be adopted *unless the staff or a commenter proves that there is a practical, beneficial alternative that would achieve at least as much energy savings over the life of the measures than would be achieved by the latest IECC standard.* That is what the Section 36-99 of the Virginia Code requires. The BHCD should eliminate its apparent policy that extends outdated, less efficient standards unless an advisory work group reaches a consensus to adopt a new standard. The burden should be on opponents of the update to demonstrate that there is a better, more energy efficient measure that should be adopted. (Thus, for example, 2009-vintage standards for building envelopes and air infiltration should not be extended simply because some builders refuse to support an update and do not propose a reasonable alternative that would achieve at least as much energy savings.) Inaction and less-efficient compromises exacted by opponents of change, under the current system, harm the Commonwealth, its economy and its residents by increasing energy costs and pollution for decades after a building has been constructed.

COMMENTS

A. Background

1. Virginia Law

Section 36-99A of the Virginia Code clearly states that the purposes of the USBC is to protect the public and adhere to recognized standards of energy conservation and water conservation:

> "The provisions of the Building Code and modifications thereof shall be such as *to protect the health, safety and welfare of the residents of the Commonwealth*, provided that buildings and structures should be permitted to be constructed, rehabilitated and maintained at the least possible cost *consistent with recognized standards of health, safety, energy conservation and water conservation*…."

The allowance to adopt variations to reduce costs does not override the requirement that the USBC be "consistent with recognized standards of … energy conservation." Further, given the overall goal of protecting the "welfare of the residents of the Commonwealth," it is clear that considerations of costs must include the lifetime of operating costs incurred by residents or businesses that own or rent dwellings and other buildings covered by the USBC.

Furthermore, Virginia Code Section 36-99B is clear that building codes adopted by the International Code Council, including the IECC, are among the "nationally recognized" standards to which the BHCD is supposed to look when formulating the USBC. ("[T]he Board shall have due regard for generally accepted standards as recommended by nationally recognized organizations, including, but not limited to, the standards of the International Code Council….") In this regard, the BHCD can also consider other nationally recognized organizations that establish standards for energy conservation, including organizations creating standards such as EarthCraft, LEED, Passive House, etc. Indeed, because of the growing climate crisis and Virginia's commitment to move to zero carbon emissions from the electric sector and slash carbon emissions generally, BHCD should already be looking at how to implement building codes that achieve greater energy efficiency than the 2018 IECC, moving to have new dwellings achieve net-zero or passive status, with renewable energy capabilities in addition to maximum efficiency levels.

With respect to rehabilitation of existing buildings, Virginia Code Section 36-99.01 recognizes the "urgent need to improve the housing conditions of low and moderate income individuals and families [and] to improve the existing condition of many of the Commonwealth's stock of commercial properties." It expresses concern that building codes have "sometimes led to the imposition of costly and time-consuming requirements that result in a significant reduction in the amount of rehabilitation activity taking place," and authorizes BHCD to address the problem where it exists. However, that general concern neither requires nor justifies eliminating or relaxing energy efficiency standards which are money-savers. Low and moderate income residents are not helped by eliminating rehabilitation measures that will lower their utility bills and help them live comfortably and affordably in the rehabilitated buildings.

2. Larger Context

Much has happened since the BHCD voted, in December 2019, to propose the USBC amendments that appeared in the Virginia Register dated February 3, 2020. Since then, the General Assembly (GA) passed and the Governor signed the Virginia Clean Economy Act (VCEA),[1] which committed Virginia to achieving zero-carbon emissions from electric generation by 2045, requires investor-owned utilities to implement programs to improve its customers' energy efficiency, and to shift increasingly to renewable energy sources. Virginia's GA and Governor also decided that Virginia should join the Regional Greenhouse Gas Initiative, which implements a regional carbon market for electric generators and will yield funds dedicated, in part, to improving energy efficiency in low-income dwellings.[2] To achieve the dramatic carbon and energy reductions called for by the VCEA, it is more critical than ever that energy efficiency be a cornerstone of building construction and rehabilitation. Reducing energy consumption is critical to reducing carbon-emitting generation and to minimizing costs of transitioning to a clean economy. In contrast, continuing to construct inefficient buildings will harm Virginia for decades, long after GHG emissions need to reach net-zero in order to avoid

[1] https://lis.virginia.gov/cgi-bin/legp604.exe?201+ful+CHAP1193 .
[2] https://lis.virginia.gov/cgi-bin/legp604.exe?201+ful+CHAP1219+pdf

enormous harms to people, property, the economy and our natural heritage.[3] Climate change is already happening and accelerating due to emissions of heat trapping pollutants from combustion of fossil fuels, much of which is attributable to electricity and natural gas used in residential and commercial buildings. Virginia is highly vulnerable to rising seas, salt water infiltration, health and agricultural impacts from rising temperatures, harms from more intense storms, and destruction of Virginia's natural heritage.[4]

Of course, energy efficiency is critical for minimizing energy costs, even apart from climate and health impacts of pollution. *A customer's best defense against utility rates is to reduce energy usage – and therefore utility bills -- by maximizing the energy efficiency of buildings and appliances.* The possibility that utility rates may rise underscores how maximizing energy efficiency in buildings is critical to minimizing future electric bills to Virginia's residents and businesses. If utility rates rise faster in the future for any reason, past cost-benefit analyses of building code updates understate the economic value of maximizing savings through increased energy efficiency.

BHCD should also consider the fact that, under measures adopted in the last two GA sessions, Virginia's utilities and government are projected to spend well over $1 billion to improve energy efficiency in existing buildings.[5] Since retrofits (particularly of building envelopes and air infiltration) are much more costly than installing efficiency measures at the outset, the BHCD should be doing all it can to maximize energy efficiency in new construction and rehabilitation of existing buildings. It makes no sense for building codes to allow builders to short-change occupants' energy efficiency in either new or rehabilitated structures, only to force the government to step in at much higher costs to retrofit to efficiency levels the builder could have achieved much more cheaply.

It is hard to overstate the importance of maximizing energy efficiency when a building is constructed or rehabilitated. Nationally, buildings represent 70% of electricity consumption, 54% of natural gas consumption, and 40% of overall energy consumption, with the average building standing for more than 70 years.[6] Not only will occupants' energy bills be elevated by building inefficiencies, but inefficient buildings will become economically less attractive to tenants and buyers, thereby lowering property values compared to more efficient buildings. In addition, studies show that owners of energy efficient homes are less likely to default on their

---

[3] *See* U.S. Global Change Research Program, 4th National Climate Assessment, Volume 1: Climate Science Special Report, https://science2017.globalchange.gov/ , Volume II: Impacts, Risks and Adaptations in the United States, https://nca2018.globalchange.gov/ For Virginia specific impacts, see footnote 2.

[4] See Georgetown Climate Center https://www.georgetownclimate.org/files/report/understanding-virginias-vulnerability-to-climate-change.pdf; NRDC, https://assets.nrdc.org/sites/default/files/climate-change-health-impacts-virginia-ib.pdf ; States At Risk, https://statesatrisk.org/virginia/all ; Virginia Department of Health, https://www.vdh.virginia.gov/commissioner/administration/climate-and-health/

[5] Under Virginia law, Virginia's largest utilities are required to spend over $1billion on energy efficiency improvements in the 10 years ending July 1, 2028. https://lis.virginia.gov/cgi-bin/legp604.exe?181+ful+CHAP0296 In addition, half the funds received by the Commonwealth from RGGI carbon auctions will go to energy efficiency. Those are only two of the measures devoted to energy efficiency.

[6] Alliance to Save Energy, https://www.ase.org/buildings .

mortgages. This should not be surprising because the owners are required to spend less of their money on utility bills.

Low and moderate income residents are particularly vulnerable to excess energy bills attributable to inefficiency both because a higher percentage of their incomes goes to utility bills and because they are more likely to occupy older, less efficient dwellings.[7] This was emphasized by Governor Northam in Executive Order 43 (Sept. 16, 2019), which identified the importance of expanding clean energy and energy efficiency for low income residents, including through building codes. He stated, among other things,

> Low-income households pay proportionately more than the average household for energy costs and often experience negative long-term effects on their health and welfare. Research from the American Council for an Energy-Efficient Economy states that "the overwhelming majority of single family and multifamily low-income households (those with income at or below 80% of area median income), minority households, low-income households residing in multifamily buildings, and renting households experienced higher energy burdens than the average household in the same city." Clean energy innovation and energy efficiency strategies can alleviate this burden, lower energy bills, and provide access to clean energy for all Virginians. No segment of the population should bear disproportionately high or adverse effects from pollution and climate disturbance, and as we increase investments in clean energy, equity must be part of the framework." [footnotes omitted.]

Given buildings lengthy lifespans, it is critical that all new and rehabilitated buildings be designed to minimize their direct and indirect carbon footprints. Building codes should be written to accelerate increases in energy efficiency and greater access to renewable energy. Virginia and its citizens will save money and experience less severe health and climate impacts by our maximizing energy savings now and into the future. Virginia's economy will be enhanced by moving to the leading edge of building energy efficiency, which will help to retain and attract businesses in the years ahead. Relying on future retrofitting will be costly and waste energy in the meanwhile.

As the Governor and Legislature have recognized, Virginia is highly vulnerable to climate change impacts and its residents are already experiencing those harms, which will only get worse in the years ahead.[8] Strengthening the efficiency and clean energy elements of the building code is needed now, not years down the road.

---

[7] The VA Poverty Law Center reports that "On average Virginia households experience an already higher than average electricity burden of 3.1%, compared to a national average of 2.7%. 'Electricity burden' is the percentage amount of your household income that is spent on electricity costs. Financial advisors agree that an average of 6% for your entire energy burden is 'affordable.' Virginian's higher than average electricity burden is unaffordable for over 75% of Virginia's households." https://vplc.org/electricity-burden-and-the-myth-of-virginias-rate-utopia/

[8] Executive Order 43 states (p. 1-2): "Climate change is an urgent and pressing challenge for Virginia. As recent storms, heat waves, and flooding events have reminded us, climate disruption poses potentially devastating risk to Virginia. The electric power sector represents approximately 30% of the carbon dioxide emissions in Virginia and is central to our efforts to address the problem. The reports from the United Nations Intergovernmental Panel on

As required by Virginia Code Section 36.99, these factors affecting the "health, safety and welfare of the residents the Commonwealth" must shape BHCD's consideration of the issues in this proceeding.

B. Specific Recommendations for Changes to the USBC.

1. Meet or Exceed the 2018 IECC in All Respects

At a minimum, the USBC should be updated to meet or exceed 2018 IECC energy conservation standards for all forms of construction and rehabilitation. Virginia's USBC has lagged the energy conservation requirements of the IECC since at least 2012.

There is no legitimate justification for falling behind the IECC, let alone staying behind for multiple cycles. Construction in Virginia is not unusual or so distinctive as to justify its being so far behind the nationally recognized IECC promulgated by the ICC since 2012. Virginia law requires that the USBC protect "*the health, safety and welfare of residents in the Commonwealth*" and to be "*consistent with recognized standards of health, safety, energy conservation and water conservation*…."

Minimizing costs of construction is a goal but only to the extent the USBC protects the *"health, safety and welfare of residents"* and remains "*consistent with recognized standards of health, safety, energy conservation and water conservation*…" Home builders' desires to minimize their costs cannot justify undercutting recognized energy conservation standards, nor can they justify harming the "welfare of residents" who will bear decades of higher energy costs as a result of cutting efficiency corners at the outset.

The energy efficiency measures contained in the IECC should, therefore, be fully incorporated into the USBC for new construction and for rehabilitation of existing buildings. When the 2012 IECC was adopted, DOE calculated that implementing the new provisions would be cash positive for homebuyers from the first month and would soon recoup all the incremental construction costs.[9]

As proposed below, the BHCD should also go beyond the 2018 IECC to move Virginia closer to the efficiency levels of the forthcoming 2021 IECC or to other important efficiency standards established by the U.S. Building Council (LEED), EarthCraft, and other organizations. These are realistic standards and achieving higher levels of efficiency will benefit owners and

---

Climate Change and Fourth National Climate Assessment make clear that swift decarbonization and a transition to clean energy is required to meet the urgency of the challenge." In addition, as noted above, earlier this year, the Virginia General Assembly enacted and the Governor signed by the Virginia Clean Economy Act and Clean Energy and Community Flood Preparedness Act to address climate change through energy efficiency and other measures to reduce CO2 emissions.

[9] DOE, National Energy Cost Savings for New Single and Multifamily Homes, A Comparison of the 2006, 2009, and 2012 Editions of the IECC, https://www.energycodes.gov/sites/default/files/documents/NationalResidentialCostEffectiveness.pdf

renters for decades. It should also use its authority to eliminate some of the least efficient options.

2. Examples of Changes to the USBC that Need to be Incorporate the 2018 IECC

The following are some of the key changes needed to make the USBC consistent with the 2018 IECC, ICC's nationally recognized standards for energy conservation. This is not an exhaustive list.

It should be noted that to the extent efficiency shortfalls are most likely to occur in lower-cost construction, it is low and moderate income buyers or tenants who are most likely to be hurt by higher heating and cooling bills for the lifetimes of the structures. Since we know that each of these measures saves money and each is a small percentage of the cost of a new home, there is no good reason to perpetuate outdated, inefficient measures in the USBC.

a. **Building envelopes**.

As proposed in the February 3, 2020 Virginia Register, the Virginia's USBC for residential buildings would continue to incorporate building envelope standards that were included in the 2009 IECC (and possibly earlier codes). Those standards were superseded by the 2012, 2015 and 2018 IECCs, but were never adopted into Virginia's USBC.

Such outdated building envelope standards have no place in Virginia's USBC. They will harm residents, particularly low and moderate income residents, for decades with higher energy bills.

Based on information from the Responsible Energy Codes Alliance, adopting the 2018 standards for walls and ceilings would add approximately $614 to the construction cost of a new single-family home in Virginia but would save buyers or renters an average of more than $100 per year. The cost would be fully repaid in annual savings within 6 years (even at current energy costs), and the savings would continue for decades.

Wall Insulation. Like the 2012 and 2015 IECCs, the 2018 IECC would require that walls be constructed to meet standards of R.20 or R.15+5. That is substantially more insulation than the R.15 or R13+1 which the proposed rule would carry forward from the 2009 code. Wall insulation is particularly important both because it pays back quickly and because retrofitting insulation in the walls of a house would require major reconstruction.

Ceiling insulation. Like the 2012 and 2015 IECCs, the 2018 IECC would require ceilings in new dwellings to be insulated to R.49, not R.38 that the pending proposal would extend from the 2009 cycle. Adding ceiling insulation is low cost and saves money.

b. **Air Infiltration and Blower Door Testing**

It is very important to revise the air infiltration limitation down to 3 air changes per hour and to require blower door testing. The pending proposal would finally require blower door testing, but it would continue to allow 5 air changes per hour. That is not enough.

Reducing the maximum air infiltration to 3 air changes per hour was technically and economically established when the 2012 IECC was promulgated, and the IECC requirement has remained at 3 air changes per hour in both the 2015 and 2018 IECC. There is no excuse for Virginia to continue to permit leaky houses that require additional heating and cooling in order to offset the infiltration of outside air. That drives up utility costs for occupants and air pollution for all of Virginia from avoidable fossil fuel combustion. To the extent lower cost construction is most likely to avoid sealing leaks, it is low and moderate income buyers or tenants who are most likely to be hurt. There is no reason why builders, informed by blower door tests and other techniques (infrared cameras, for example), should not be able to identify and seal leaks to reduce infiltration to 3 air changes per hour.

3. Efficiency Standards Should Not Be Relaxed for Existing buildings

Virginia Code Section 36-99.01 recognizes the "urgent need to improve the housing conditions of low and moderate income individuals and families [and] to improve the existing condition of many of the Commonwealth's stock of commercial properties." Although it expresses concern that building codes have "sometimes led to the imposition of costly and time-consuming requirements that result in a significant reduction in the amount of rehabilitation activity taking place," it only directs the BHCD to *consider* the issue. It does not direct the BHCD to relax energy efficiency standards for rehabilitation of existing buildings, nor should the BHCD do so. Relaxing efficiency standards in rehabilitation projects will harm the very low and moderate income individuals and families that the legislation was intended to help.

Improving energy efficiency should be a critical element of any rehabilitation project.[10] Failing to meet IECC standards for renovating existing buildings will simply mean that buyers or renters will incur higher utility bills that exceed the cost of borrowing funds to pay for the efficiency measures. Before long, the lost savings to a buyer or tenant will exceed the costs that the builder avoided by failing to address the efficiency issues. It is neither in the customer's interest nor the public's interest to extend the lives of inefficient buildings. The code should be clear that energy efficiency standards are an important part of renovations of existing buildings and should not be waived by local officials.

For example, the proposal to delete R503.1.1.1 should be rejected. Window replacements should have U-Factors and SHGC factors that are equivalent to those the IECC would require for new buildings. In reality, most of the costs related to window replacements result from the decision to replace the windows in the first place – the difference between a code-compliant window and a noncompliant window is typically a very small incremental cost difference. Leaving no standard could result in considerable waste of energy going forward. Moreover, homeowners may believe that they are getting all the benefits of more efficient windows, but in the absence of a specific code requirement, they may not realize that

[10] ACEEE recently discussed the importance of accelerating efficiency retrofits of existing buildings in *Mandatory Building Performance Standards: A Key Policy for Achieving Climate Goals* (2020), https://www.aceee.org/sites/default/files/pdfs/buildings_standards_6.22.2020_0.pdf

replacement windows do not meet the same U-factors or SHGCs that would be required for new construction.

Beyond that alterations to the building should generally follow the requirements for new buildings when new materials are installed. At a minimum, for example, when walls are opened, wall insulation should be maximized for the available space. When there is access to a ceiling, more insulation should be added. (When appliances are replaced, builders should be incentivized to the extent possible to install high-efficiency appliances, preferably Energy Star.) Central heating systems that rely on electric resistance heat should be replaced with more efficient heat pumps. These types of requirements should be consistently enforced by building inspectors.

4. Additional Requirements for New Buildings

As discussed below, the BHCD should be taking all reasonable steps to reduce energy consumption in buildings, including going beyond the 2018 IECC. It should also be taking steps to prepare new buildings to be able to meet the growing demand for electric vehicle charging. Buildings undergoing major renovations should also meet these requirements.

a. Builders Should be Required to Choose an *Additional Measure* From a List of Energy-Saving Options

New construction presents the opportunity to incorporate additional measures to reduce energy usage. We urge the BHCD to require builders of new residential buildings to adopt at least one of the following measures in addition to all of the mandatory efficiency measures in the 2018 IECC. These recommendations are all based upon provisions we expect to see in the 2021 IECC, which we anticipate will be finalized before the BHCD issues a final rule in this proceeding.

1. **Better insulation**. Meet the wall and ceiling insulation requirements equal to or better than R.20+5 or R13+10 for walls and R. 60 for ceilings, which are expected to be in the forthcoming 2021 IECC for Climate Zone 4;
2. **Better ERI**. Meet the expected 2021 IECC baseline ERI of 54 for Climate Zone 4;
3. **More efficient HVAC**. Install heating and cooling equipment that meets or exceeds one of the following:
    a. Greater than or equal to 95 AFUE natural gas furnace and 16 SEER air conditioner
    b. Greater than or equal to 10 HSPF / 16 SEER air source heat pump
    c. Greater than or equal to 3.5 COP ground source heat pump.

    For multiple cooling systems, all systems shall meet or exceed the minimum efficiency requirements in this section and shall be sized to serve 100% of the cooling design load. For multiple heating systems, all systems shall meet or exceed the minimum efficiency requirements in this section and shall be sized to serve 100% of the heating design load.

4. **Reduced energy service use in service water heating option**. The hot water system shall meet or exceed one of the following efficiencies:
    a. Greater than or equal to 82 EF fossil fuel service water heating system;
    b. Greater than or equal to 2.0 EF electric service water heating system;
    c. Greater than or equal to 0.4 Solar Fraction solar water heating system.

b. BHCD Should Use its Authority to Prohibit Certain Forms of Heating in New Residences

In addition to its other authorities to regulate building construction, Section 36-99.6:3 of the Virginia Code states:

> "**Regulation of HVAC facilities**. The Board shall promulgate regulations in accordance with the Administrative Process Act (§ 2.2-4000 et seq.) establishing standards for heating, ventilation, and air conditioning (HVAC) facilities in new, privately owned residential dwellings."

a. Resistance Space Heating. The BHCD should use that authority to prohibit installation of electric resistance space heating (baseboard or electric furnace) in new residential dwellings of all sizes. Electric resistance is very inefficient compared to electric heat pumps, including mini-splits. Indeed, electric heat pumps have 3-4 times the energy efficiency of resistance heat. Resistance heat increases user costs, air pollution and peak utility demands. It is cheap to install but very expensive to operate and environmentally harmful.

Georgia has adopted mandatory building code provisions (R403.1.2) that (**a) prohibit resistance heat as a primary source of heat in new dwelling units or as replacements for heat pumps in existing units, and (b) require that operation of resistance heating elements in heat pumps be restricted to periods when heat from the heat pump is inadequate. This is a reasonable solution, which Virginia should adopt.**

Consequently, the USBC should be amended to bar the use of resistance heat except as a supplement to an electric heat pump during very cold periods. Central heat pumps include resistance heat and mini-splits do not. Both central heat pumps and mini-splits will save money for customers and minimize the use of baseboard resistance heating. With a highly efficient electric heating technology available, the least efficient form of electric heat should be prohibited.

b. Gas Furnaces. The Board should also use its authority, under 36-99.6.3, to prohibit future installations of gas furnaces in new, privately owned residential dwellings. Combustion of gas in the home compounds carbon emissions harmful to the planet and contributes to indoor air pollution that go beyond carbon dioxide. Methane emissions associated with natural gas at every stage from production to consumption also increase climate change, particularly since methane is approximately 86 times more potent than

carbon dioxide as a heat-trapping gas, over 20 years.[11] In contrast, high efficiency electric heat pumps, which will increasingly be powered by zero-carbon solar and wind generation, are more energy efficient, will reduce carbon pollution and avoid indoor air pollution that results from combusting or leaking natural gas.[12] The growing climate crisis and the importance of reducing indoor air pollution warrant implementation of this limitation on new natural gas furnaces.

c. Virginia's USBC Should Require Electric Readiness

Gas appliances – space heating, water heating and stoves – are significant sources of carbon pollution and unhealthy indoor air pollution. Ideally, builders would transition *now* to all-electric alternatives. However, **at a minimum, new dwellings should be wired so that homeowners can make cost-effective choices to switch to electric appliances, in the future.** That can be done at minimal incremental cost when walls are open and the electrical "bones" of a house are being installed, including wiring to serve all types of appliances.

Appropriate language can be found in Proposal RE147-19 (IRC N1104,2-N1104.2.3) which was adopted in the course of approving the 2021 IECC, which is now in its final phases. Adopting such a requirement will protect homeowners' health and welfare by preserving their options to switch to electric appliances either by choice or because natural gas appliances are eventually phased out due to pollution or other factors. It will protect the Commonwealth by encouraging future reductions of indoor and outdoor pollution.

d. Solar Readiness

The BHCD should move ahead with provisions requiring solar readiness in construction of new single-family dwellings and townhouses. As Governor Northam recognized in EO43, clean energy sources need to be developed for the benefit of the Commonwealth. Rooftops present an excellent opportunity for installing solar panels. However, homeowners' chances of installing solar PV panels or solar water heating will be diminished if a house is poorly oriented to the sun or lacks roof strength or other basic preparations (*e.g.*, electrical conduits). Even without requiring installation of solar energy facilities, the BHCD should at least provide for solar readiness in detached single family and townhouses to the extent feasible. **Appropriate language can be found in the 2018 IECC appendix dealing with solar readiness.** https://codes.iccsafe.org/content/iecc2018/appendix-ra-solar-ready-provisions-detached-one-and-two-family-dwellings-and-townhouses .

---

[11] "The drilling and extraction of the fuel from wells, as well as its processing, transmission, distribution, and storage, also result in the leakage of methane—a primary component of natural gas that is 34 times stronger than carbon dioxide at trapping heat over a 100-year period and 86 times stronger over 20 years (Myhre et al. 2013)." Union of Concerned Scientists, The Natural Gas Gamble: A Risky Bet on America's Clean Energy Future (March 2015), p. 16. The report adds: "Although there is still uncertainty about the precise quantity of these so-called fugitive methane emissions, preliminary studies and field measurements range from 1 to 9 percent of total natural gas production.

[12] Indirectly, installing a natural gas furnace will increase the probability that a gas stove will be installed. Gas stoves are a particularly large source of indoor air pollution. https://rmi.org/insight/gas-stoves-pollution-health ;

e. Electric Vehicle Charging Capabilities

Electric vehicles (EVs) are growing in importance and will continue to grow in importance as climate risks compel shifting to vehicles that do not emit pollution. Vehicles are Virginia's largest source of carbon-dioxide emissions from fossil fuel combustion.[13] Those emissions would be substantially reduced by switching to EVs, and the emissions associated with EVs will decline more as zero-carbon renewable energy replaces fossil-fuel generation. *Even based on today's mix of generation in Virginia, DOE estimates that EVs would reduce CO2 emissions by roughly two-thirds compared to vehicles combusting gasoline*.[14] Furthermore, EV electricity charging during off-peak periods can lead to a reduction of rates to all consumers.[15]

Forecasts of EV growth are substantial over the next 10 years and beyond with the Edison Electric Industry estimating that more than 20% of new vehicle sales will be EVs by 2030, and other estimates go as high as 33% by 2030.[16] At-home charging in conjunction with single or multifamily parking is particularly important to meeting the needs of EV owners and to encourage charging during overnight periods rather than during utilities' peak demand periods.[17] Charging EVs is generally slower than pumping gasoline or diesel vehicles, and the public infrastructure for charging is still very limited. At-home charging resolves both of those difficulties.

Experience shows that installing a simple 220V/40 Ampere outlet (comparable to a dryer outlet) in a garage will enable an EV owner to conveniently schedule battery charging at night or otherwise outside the utilities peak demand period. (The presence of the wiring would permit low-cost installation of a different charging system in the future.)

While it is easy to install the wires, panel capacity and conduits for electric vehicle charging—along with the rest of a dwelling's wiring--when a single or multifamily dwelling is built, it is much harder and much more expensive to do so as a retrofit.[18]

---

[13] https://www.epa.gov/sites/production/files/2019-11/documents/co2ffc_2017.pdf

[14] DOE estimates that an EV in Virginia emits (via electric generation) less than a third as much CO2 as a gasoline-driven vehicle. https://afdc.energy.gov/vehicles/electric_emissions.html ; https://evtool.ucsusa.org/

[15] See June 23 Comments of the Sierra Club to the State Corporation Commission in Docket PUR-2020-00051, Electrification of Motor Vehicles. As the comments explain, with managed off-peak charging and rates, rising EV loads can drive down rates to all customers.

[16] https://www.edisonfoundation.net/-/media/Files/IEI/publications/IEI_EEI-EV-Forecast-Report_Nov2018.ashx ; June 23 Comments of the Sierra Club, note 15, supra. The Sierra Club also notes the figures could be much higher with appropriate policies.

[17] Utilities' energy sales are lowest and cheapest in off-peak hours, particularly at night. One strategy is to design time-of-use rates with low night-time prices to encourage off-peak EV charging. For EV customers to make use of such incentives, they will need access to overnight charging at home where they spend the night.

[18] In submissions to the IECC as part of the 2021 IECC process, data indicated that the cost of retrofitting commercial parking to EV ready status would be 3-8 times higher than doing to work at the time of building construction. See Proposed CE217-19 Part 1.(Cost Impact discussion). The submission's statement of reasons also documented the large increases projected for the number of EVs expected to be on the road, rising from 1 million

Accordingly, we urge the BHCD to require installation of EV charging capabilities and readiness when new single-family and multi-family residences--including high-rise residential classified as "commercial" in the building code--are constructed. At that point the initial costs are low, but an owner or tenant will not be inhibited from buying an EV due to uncertainty about the availability of charging.

It would also be desirable to require EV charging capabilities and readiness for non-residential commercial parking areas. This is particularly important for people who do not have and, in some cases, cannot install EV charging at home (*e.g.*, because they only have street parking). Again, incorporating the infrastructure into new commercial buildings can be achievable at a lower cost if it is done at the outset.

Attached as Appendix B is our proposal to require minimum levels of EV charging in new single family and multifamily residential construction that includes parking (garage or outdoor). This requirement should be applied to multifamily construction classified as commercial, as well as low-rise multifamily. The language in Appendix B is based upon language in the near-final 2021 IECC (CE217-19 Parts 1 and II), which also has parallel language for EV charging in the commercial code which should be used at least for multifamily construction under the commercial code. While we support the idea of requiring EV charging capabilities in all commercial buildings, our proposal hear is limited to residential dwellings, including low-rise and high-rise multifamily dwellings. It is based on our understanding of what has been included so far in the 2021 IECC. As long as it is adopted, we would not object to it being incorporated into another portion of the 2021 ICC (e.g., possibly electrical or mechanical).

f. Zero Energy Residential Buildings Option

The Board should adopt a zero-energy option for builders, which would allow them to advertise a net-zero energy dwelling if implemented and which would provide a more uniform set of net-zero-energy provisions that could be applied across the Commonwealth. **As incorporated into the nearly final 2021 IECC, Proposal RE223-19 would add an appendix that would define the central elements of "Zero Energy Residential Buildings." In brief, a residential structure would qualify, in Climate Zone 4, if it achieves a Energy Rating Index (ERI) score, calculated pursuant to RESNET/ICC301), of equal to or less than 47 not including onsite power production and a score of 0 including onsite power production.**

Creating this option may incentivize builders to meet those goals so they can advertise zero energy construction. That information could benefit interested buyers as well as builders.

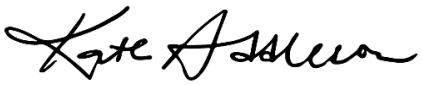
C. Conclusion

In summary, we strongly urge the BHCD to adopt final rules for a revised building code that (1) contains all of the provisions of the 2018 IECC for new construction and for rehabilitation of existing buildings; (2) exceeds the efficiency requirements of the IECC in certain important

at the end of 2018 to 18.7 million by 2030. Every major carmaker has announced plans for significant EV production increases over then next 5 years.

respects, and (3) adds a requirement for solar readiness and EV charging capabilities and readiness and an option for zero energy construction.

Respectfully submitted,



Kate Addleson, Director
William Penniman, Sustainability Chair

Virginia Chapter of the Sierra Club
100 W Franklin St, Mezzanine
Richmond, VA 23220
Phone: 804-225-9113

Eric Goplerud, Chair
Faith Alliance for Climate Solutions

Jo Anne St. Clair, Chair
Climate Action Alliance of the Valley

June 25, 2020

APPENDIX A - DESCRIPTIONS OF COMMENTING PARTIES

The Virginia Chapter of the Sierra Club has over 19,000 members. The Sierra Club is a non-profit, membership organization dedicated to exploring, enjoying and protecting wild places; to promoting the responsible use of the Earth's resources and ecosystems; to educating and enlisting humanity to protect and restore the quality of the natural and human environment; and to using all lawful means to carry out those objectives.

The Faith Alliance for Climate Solutions is a non-profit organization with more than 75 faith communities and 2,400 faith-based activists in Northern Virginia whose mission is to develop local solutions to climate change.

Climate Action Alliance of the Valley (CAAV) is an organization of residents of the Shenandoah Valley. CAAV's mission is to limit the impact of humans on Earth's climate and minimize the effects of inevitable climate change in order to protect the future for Earth and its inhabitants. The vision of CAAV is to create and nurture climate action in our Shenandoah Valley community so that we can become a regional leader in promoting climate change mitigation and resilience. CAAV seeks to achieve policies and legislation that advances the systemic changes required to promote climate stabilization and resilience.

APPENDIX B
PROPOSED ADDITION TO ADDRESS RESIDENTIAL EV CHARGING IN NEW SINGLE AND MULTIFAMILY RESIDENTIAL CONSTRUCTION

Section R202 (IRC N1101.6)
General Definitions

Electric Vehicle Supply Equipment (EVSEL). The conductors, including the ungrounded, grounded, and equipment grounding conductors, and the Electric Vehicle connectors, attachment plugs and all other fittings devices, power outlets or apparatus installed specifically for the purpose of transferring energy between the premises wiring and the Electric Vehicle.

EV Capable Space. Electric panel capacity and space to support a minimum 40-ampere, 208/240-volt branch circuit for each EV parking space, and the installation of raceways, both underground and surface mounted, to support the EVSE.

EV Ready Space. A designated parking space which is provided with one 40-ampere, 208/240-volt branch circuit for EVSE servicing Electric Vehicles. The circuit shall terminate in a suitable termination point such a s receptacle, junction box, or an EVSE, and be located in close proximity to the proposed location of an EV parking spaces.

R404.2 (IRC N1104.2) Electric Vehicle (EV) charging for new construction. New construction shall facilitate future installation and use of Electric Vehicle Supply Equipment (EVSE) in accordance with the NFPA 70.

R404.2 (IRC N1104.2.1) New Residential Buildings. One-to two-family dwellings and townhouses. For each dwelling unit for which parking is provided, provide at least one EV Ready Space. The branch circuit shall be identified as "EV Ready" in the service panel or subpanel directory, and the termination location shall be marked as "EV Ready.

R402.2.2 (IRC N1104.2.2) Multifamily Dwellings (three or more units). EV Ready Spaces and EV Capable Spaces shall be provided in accordance with Table R404.2.2. Where the calculation of a percent served results in a fractional parking space, it shall be rounded up to the next whole number. The service panel or subpanel circuit directory shall identify the spaces reserved to support EV charging as "EV Capable" or "EV Ready". The raceway location shall be permanently and visibly marked "EV Capable".

Table R404.2.2 (IRC N1104.2.2)
EV Ready Space and EV Capable Space Requirements

Total Number of Parking Spaces	Minimum number of EV Ready Spaces	Minimum Number of EV Capable Spaces
1	1	
2-10	2	
11-15	2	3
16-19	2	4
21-25	2	5
26+	2	20% of total parking spaces

Adopt the 2018 IECC

We urge Virginia to adopt, at a minimum, the 2018 IECC without any amendments that would weaken the efficiency of the code. Currently Virginia follows the 2015 IECC, but with weakening amendments. Given the scope and magnitude of the climate crisis, it is important for new buildings to be built as efficiently as possible, and as soon as possible. A number of other states, including neighboring Maryland, have adopted energy codes that are at least as efficient as the 2018 IECC, and with no weakening amendments.

Compared to the current USBC, the 2018 IECC includes more stringent requirements for building envelope improvements, including better wall insulation, ceiling insulation, and air infiltration requirements. These measures will cost about $600 more to install at the time of construction. However, according to analysis by the Responsible Energy Codes Alliance, improved insulation requirements will save upwards of $100 *each year* – savings that continue through every year of the life of the building.

People who purchase new construction homes tend to have higher incomes, with nearly half reporting a household income of more than $100,000. However, long-term savings measures installed at the time of construction are important for lower income residents, as well. The second, third, or fourth owners or occupants of any given home may be households with lower incomes. The benefits of measures like insulation will last for the lifetime of the home, and will benefit subsequent homeowners or renters.

Likewise, improved efficiency is especially important in multifamily buildings, which tend to be rented rather than owned. Renters have very little control over the building envelope and equipment, and can suffer the consequence of high energy bills with no way to improve the building. Constructing efficiently from the start will mean lower bills and better health and comfort for years to come.

Additional Improvements Mean More Benefits

Adopting the 2018 IECC without weakening amendments should be the absolute minimum.

There are a number of additional strengthening proposals that should be considered and adopted.

Require electric readiness

A key component of the fight against costly climate change is reducing the use of fossil fuels, including fossil fuels used on site in a building for water heating, space heating, clothes drying, and cooking. Preparing a building for future electrification of some of these end uses is straightforward and inexpensive at the time of construction: it simply requires the appropriate electrical outlet and spacing for future electric appliances. Doing so protects homeowners from future costs, should natural gas become less affordable or even unavailable over the life of the building. In addition, there are substantial indoor air quality benefits from choosing electric

equipment over fossil fuel combustion equipment, which could be very important for people with certain health conditions.

As the electric grid becomes cleaner, and high-efficiency electric heat pump technology increasingly offers utility bill and pollution reduction benefits over gas, more customers may want to transition from natural gas to electric space and water heating. Federal, state, and local environmental and public health policies may also encourage, or even require the transition in some areas. Electric-ready requirements will protect customers from high retrofit costs. Proposal RE147-19 was recently adopted into the 2021 IECC, and language in that proposal should be considered for adoption in Virginia.

Require electric vehicle readiness

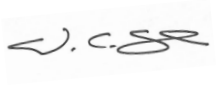
Similar to making a building ready for future electrification of end uses, homes, multifamily buildings, and commercial buildings should be required to meet electric vehicle (EV) readiness requirements. This does not mean installing a full EV charging system, but simply ensuring that the proper wiring, circuitry, and electrical panel space is available for the installation of a future EV charger. The cost savings of installing EV capability at the time of construction is immense: a 2018 study by the California Air Resources Board found a cost savings of up to $8,000 by installing EV charging infrastructure in commercial/multifamily buildings, as compared to the cost of retrofitting. Proposals CE217-19 Part 1 and CE217-19 Part 2 were both adopted as part of the 2021 IECC, and should be considered as an appropriate model for electric vehicle readiness.

Continual Improvement

Virginia's building code has lagged behind the model IECC codes for far too long. Given the magnitude of the power plant carbon reductions required under the Virginia Clean Economy Act, Virginia must prioritize the energy efficiency of its new construction. Adopting a clean 2018 code is a start, but progress must continue. We request that the Board of Housing and Community Development adopt a policy committing Virginia to adopt the most recent IECC, without weakening amendments, each time it is updated. Failure to do so will mean higher bills for residents and businesses, more wasted energy, and more climate pollution for decades to come.

Better building codes are a common-sense way to address costly climate change while saving money and energy in the immediate term.

Updating to the 2018 IECC, without weakening amendments, is a great start – but it doesn't go far enough. Committing to more energy efficiency both now and in the future will mean a healthier, cleaner Virginia for all.
Thank you,



Walton C. Shepherd

Commonwealth of Virginia
Before The
Board of Housing and Community Development

COMMENTS ON PROPOSED AMENDMENTS TO THE UNIFORM STATEWIDE BUILDING CODE OF THE VIRGINIA CHAPTER OF THE SIERRA CLUB, FAITH ALLIANCE FOR CLIMATE SOLUTIONS, CLIMATE ACTION ALLIANCE OF THE VALLEY

The Virginia Chapter of the Sierra Club, Faith Alliance for Climate Solutions, Climate Action Alliance of the Valley hereby comment on the pending proposal to update Virginia's Uniform Statewide Building Code (USBC).

STATEMENT OF INTEREST

These comments are submitted by the Virginia Chapter of the Sierra Club, Faith Alliance for Climate Solutions and Climate Action Alliance of the Valley. Each of these organizations has members who reside in Virginia and whose dwellings, health, welfare and energy costs may be affected by the outcome of these proceedings. Particularly, now that climate change is bearing down on Virginia's residents, environment and economy, it is more critical than ever that Virginia's building codes maximize energy efficiency in new and rehabilitated buildings, both residential and commercial. In addition to minimizing energy consumption, it is also important that buildings be designed, from the outset, to accommodate new carbon reducing technologies, including rooftop solar and electric vehicles.

More detailed descriptions of these organizations are attached as Appendix A.

SUMMARY OF RECOMMENDATIONS

We urge the BHCD to adopt the following changes to the energy and other provisions of the USBC:

- **Meet or exceed 2018 IECC energy conservation standards for all forms of construction covered by the USBC.** Virginia's USBC has lagged behind the energy conservation requirements of the IECC since at least 2012. However, there is nothing unique about Virginia, its residents or the capabilities of its builders which would justify adoption of any standards that would yield less energy efficiency than the 2018 IECC prescribes for new and existing buildings. To the contrary, meeting or exceeding the 2018 IECC is required to meet the needs of, and growing challenges to, Virginia's residents and economy.

- **Among other measures relevant to residential construction of new residential buildings, the BHCD should**
    - Require builders to meet the full 2018 IECC standards for envelope efficiency – particularly walls and ceilings – not extend outdated 2009 standards that were superseded by the IECC in 2012;
    - Require builders to conduct blower door test and to limit air infiltration to, at most, 3 air changes per hour, which has been the required envelope tightness measure since the 2012 IECC;
    - Require builders of new homes to implement all the efficiency standards in the IECC, plus implement an additional measure chosen from several additional measures (identified below) which would improve energy efficiency of the structure by 5-10% beyond the efficiency required by the 2018 IECC;
    - Prohibit installation of electric resistance heating (*e.g.*, electric furnace or baseboard heating) which is highly inefficient compared to modern heat pumps and "mini-splits".
    - Require electric readiness for shifting, in the future, to all-electric air and water heating.
    - Adopt a zero-energy option for builders, which would allow them to advertise a net-zero energy dwelling if implemented and which would provide a more uniform set of net-zero-energy provisions that could be applied across the Commonwealth.

- **Meet and exceed 2018 energy efficiency standards for rehabilitation of existing residential and commercial buildings.** Virginia Code Section 36-99.01 recognizes the "urgent need to improve the housing conditions of low and moderate income individuals and families [and] to improve the existing condition of many of the Commonwealth's stock of commercial properties." Although it expresses concern that rehabilitation costs have "sometimes" been raised by building codes, nothing in that section suggests that the BHCD should weaken or eliminate energy efficiency standards that will reduce renters' and buyers' energy costs, reduce pollution for the benefit of all Virginians. Tenants and buyers, particularly low and moderate income residents, are disserved by high energy bills attributable to inefficient dwellings. In addition to deep energy retrofits during rehabilitation projects, there are also opportunities to save energy every time a building is renovated. The 2018 IECC requires additions and new building materials used in alterations to meet the same level of efficiency as in new buildings, and it requires buildings undergoing a change in occupancy usage to meet reasonable efficiency requirements as well. Energy saving measures should be required with all renovations to the extent required by the 2018 IECC unless the property owner can demonstrate a better way to achieve equivalent reductions of energy costs.

- **Regardless of whether it is in the energy section or in another section of the USBC, new single and multifamily dwellings should be**

- **Required to incorporate electric vehicle charging capabilities and readiness in garages, carports and outdoor parking for single and multifamily construction;**
- **Required, to the extent possible, to incorporate or at least be oriented and pre-wired to add on-building solar energy in the future.**

Code Process. We also urge the BHCD to change its process for approving USBC updates. It should establish a clear policy that all energy efficiency improvements prescribed by new IECC standards shall be adopted *unless the staff or a commenter proves that there is a practical, beneficial alternative that would achieve at least as much energy savings over the life of the measures than would be achieved by the latest IECC standard.* That is what the Section 36-99 of the Virginia Code requires. The BHCD should eliminate its apparent policy that extends outdated, less efficient standards unless an advisory work group reaches a consensus to adopt a new standard. The burden should be on opponents of the update to demonstrate that there is a better, more energy efficient measure that should be adopted. (Thus, for example, 2009-vintage standards for building envelopes and air infiltration should not be extended simply because some builders refuse to support an update and do not propose a reasonable alternative that would achieve at least as much energy savings.) Inaction and less-efficient compromises exacted by opponents of change, under the current system, harm the Commonwealth, its economy and its residents by increasing energy costs and pollution for decades after a building has been constructed.

COMMENTS

A. Background

1. Virginia Law

Section 36-99A of the Virginia Code clearly states that the purposes of the USBC is to protect the public and adhere to recognized standards of energy conservation and water conservation:

> "The provisions of the Building Code and modifications thereof shall be such as *to protect the health, safety and welfare of the residents of the Commonwealth*, provided that buildings and structures should be permitted to be constructed, rehabilitated and maintained at the least possible cost *consistent with recognized standards of health, safety, energy conservation and water conservation*…."

The allowance to adopt variations to reduce costs does not override the requirement that the USBC be "consistent with recognized standards of … energy conservation." Further, given the overall goal of protecting the "welfare of the residents of the Commonwealth," it is clear that considerations of costs must include the lifetime of operating costs incurred by residents or businesses that own or rent dwellings and other buildings covered by the USBC.

Furthermore, Virginia Code Section 36-99B is clear that building codes adopted by the International Code Council, including the IECC, are among the "nationally recognized" standards to which the BHCD is supposed to look when formulating the USBC. ("[T]he Board shall have due regard for generally accepted standards as recommended by nationally recognized organizations, including, but not limited to, the standards of the International Code Council….") In this regard, the BHCD can also consider other nationally recognized organizations that establish standards for energy conservation, including organizations creating standards such as EarthCraft, LEED, Passive House, etc. Indeed, because of the growing climate crisis and Virginia's commitment to move to zero carbon emissions from the electric sector and slash carbon emissions generally, BHCD should already be looking at how to implement building codes that achieve greater energy efficiency than the 2018 IECC, moving to have new dwellings achieve net-zero or passive status, with renewable energy capabilities in addition to maximum efficiency levels.

With respect to rehabilitation of existing buildings, Virginia Code Section 36-99.01 recognizes the "urgent need to improve the housing conditions of low and moderate income individuals and families [and] to improve the existing condition of many of the Commonwealth's stock of commercial properties." It expresses concern that building codes have "sometimes led to the imposition of costly and time-consuming requirements that result in a significant reduction in the amount of rehabilitation activity taking place," and authorizes BHCD to address the problem where it exists. However, that general concern neither requires nor justifies eliminating or relaxing energy efficiency standards which are money-savers. Low and moderate income residents are not helped by eliminating rehabilitation measures that will lower their utility bills and help them live comfortably and affordably in the rehabilitated buildings.

2. Larger Context

Much has happened since the BHCD voted, in December 2019, to propose the USBC amendments that appeared in the Virginia Register dated February 3, 2020. Since then, the General Assembly (GA) passed and the Governor signed the Virginia Clean Economy Act (VCEA),[1] which committed Virginia to achieving zero-carbon emissions from electric generation by 2045, requires investor-owned utilities to implement programs to improve its customers' energy efficiency, and to shift increasingly to renewable energy sources. Virginia's GA and Governor also decided that Virginia should join the Regional Greenhouse Gas Initiative, which implements a regional carbon market for electric generators and will yield funds dedicated, in part, to improving energy efficiency in low-income dwellings.[2] To achieve the dramatic carbon and energy reductions called for by the VCEA, it is more critical than ever that energy efficiency be a cornerstone of building construction and rehabilitation. Reducing energy consumption is critical to reducing carbon-emitting generation and to minimizing costs of transitioning to a clean economy. In contrast, continuing to construct inefficient buildings will harm Virginia for decades, long after GHG emissions need to reach net-zero in order to avoid

[1] https://lis.virginia.gov/cgi-bin/legp604.exe?201+ful+CHAP1193 .
[2] https://lis.virginia.gov/cgi-bin/legp604.exe?201+ful+CHAP1219+pdf

enormous harms to people, property, the economy and our natural heritage.[3] Climate change is already happening and accelerating due to emissions of heat trapping pollutants from combustion of fossil fuels, much of which is attributable to electricity and natural gas used in residential and commercial buildings. Virginia is highly vulnerable to rising seas, salt water infiltration, health and agricultural impacts from rising temperatures, harms from more intense storms, and destruction of Virginia's natural heritage.[4]

Of course, energy efficiency is critical for minimizing energy costs, even apart from climate and health impacts of pollution. *A customer's best defense against utility rates is to reduce energy usage – and therefore utility bills -- by maximizing the energy efficiency of buildings and appliances.* The possibility that utility rates may rise underscores how maximizing energy efficiency in buildings is critical to minimizing future electric bills to Virginia's residents and businesses. If utility rates rise faster in the future for any reason, past cost-benefit analyses of building code updates understate the economic value of maximizing savings through increased energy efficiency.

BHCD should also consider the fact that, under measures adopted in the last two GA sessions, Virginia's utilities and government are projected to spend well over $1 billion to improve energy efficiency in existing buildings.[5] Since retrofits (particularly of building envelopes and air infiltration) are much more costly than installing efficiency measures at the outset, the BHCD should be doing all it can to maximize energy efficiency in new construction and rehabilitation of existing buildings. It makes no sense for building codes to allow builders to short-change occupants' energy efficiency in either new or rehabilitated structures, only to force the government to step in at much higher costs to retrofit to efficiency levels the builder could have achieved much more cheaply.

It is hard to overstate the importance of maximizing energy efficiency when a building is constructed or rehabilitated. Nationally, buildings represent 70% of electricity consumption, 54% of natural gas consumption, and 40% of overall energy consumption, with the average building standing for more than 70 years.[6] Not only will occupants' energy bills be elevated by building inefficiencies, but inefficient buildings will become economically less attractive to tenants and buyers, thereby lowering property values compared to more efficient buildings. In addition, studies show that owners of energy efficient homes are less likely to default on their

---

[3] *See* U.S. Global Change Research Program, 4th National Climate Assessment, Volume 1: Climate Science Special Report, https://science2017.globalchange.gov/ , Volume II: Impacts, Risks and Adaptations in the United States, https://nca2018.globalchange.gov/ For Virginia specific impacts, see footnote 2.

[4] See Georgetown Climate Center https://www.georgetownclimate.org/files/report/understanding-virginias-vulnerability-to-climate-change.pdf; NRDC, https://assets.nrdc.org/sites/default/files/climate-change-health-impacts-virginia-ib.pdf ; States At Risk, https://statesatrisk.org/virginia/all ; Virginia Department of Health, https://www.vdh.virginia.gov/commissioner/administration/climate-and-health/

[5] Under Virginia law, Virginia's largest utilities are required to spend over $1billion on energy efficiency improvements in the 10 years ending July 1, 2028. https://lis.virginia.gov/cgi-bin/legp604.exe?181+ful+CHAP0296 In addition, half the funds received by the Commonwealth from RGGI carbon auctions will go to energy efficiency. Those are only two of the measures devoted to energy efficiency.

[6] Alliance to Save Energy, https://www.ase.org/buildings .

mortgages. This should not be surprising because the owners are required to spend less of their money on utility bills.

Low and moderate income residents are particularly vulnerable to excess energy bills attributable to inefficiency both because a higher percentage of their incomes goes to utility bills and because they are more likely to occupy older, less efficient dwellings.[7] This was emphasized by Governor Northam in Executive Order 43 (Sept. 16, 2019), which identified the importance of expanding clean energy and energy efficiency for low income residents, including through building codes. He stated, among other things,

> Low-income households pay proportionately more than the average household for energy costs and often experience negative long-term effects on their health and welfare. Research from the American Council for an Energy-Efficient Economy states that "the overwhelming majority of single family and multifamily low-income households (those with income at or below 80% of area median income), minority households, low-income households residing in multifamily buildings, and renting households experienced higher energy burdens than the average household in the same city." Clean energy innovation and energy efficiency strategies can alleviate this burden, lower energy bills, and provide access to clean energy for all Virginians. No segment of the population should bear disproportionately high or adverse effects from pollution and climate disturbance, and as we increase investments in clean energy, equity must be part of the framework." [footnotes omitted.]

Given buildings lengthy lifespans, it is critical that all new and rehabilitated buildings be designed to minimize their direct and indirect carbon footprints. Building codes should be written to accelerate increases in energy efficiency and greater access to renewable energy. Virginia and its citizens will save money and experience less severe health and climate impacts by our maximizing energy savings now and into the future. Virginia's economy will be enhanced by moving to the leading edge of building energy efficiency, which will help to retain and attract businesses in the years ahead. Relying on future retrofitting will be costly and waste energy in the meanwhile.

As the Governor and Legislature have recognized, Virginia is highly vulnerable to climate change impacts and its residents are already experiencing those harms, which will only get worse in the years ahead.[8] Strengthening the efficiency and clean energy elements of the building code is needed now, not years down the road.

---

[7] The VA Poverty Law Center reports that "On average Virginia households experience an already higher than average electricity burden of 3.1%, compared to a national average of 2.7%. 'Electricity burden' is the percentage amount of your household income that is spent on electricity costs. Financial advisors agree that an average of 6% for your entire energy burden is 'affordable.' Virginian's higher than average electricity burden is unaffordable for over 75% of Virginia's households." https://vplc.org/electricity-burden-and-the-myth-of-virginias-rate-utopia/

[8] Executive Order 43 states (p. 1-2): "Climate change is an urgent and pressing challenge for Virginia. As recent storms, heat waves, and flooding events have reminded us, climate disruption poses potentially devastating risk to Virginia. The electric power sector represents approximately 30% of the carbon dioxide emissions in Virginia and is central to our efforts to address the problem. The reports from the United Nations Intergovernmental Panel on

As required by Virginia Code Section 36.99, these factors affecting the "health, safety and welfare of the residents the Commonwealth" must shape BHCD's consideration of the issues in this proceeding.

B. Specific Recommendations for Changes to the USBC.

1. Meet or Exceed the 2018 IECC in All Respects

At a minimum, the USBC should be updated to meet or exceed 2018 IECC energy conservation standards for all forms of construction and rehabilitation. Virginia's USBC has lagged the energy conservation requirements of the IECC since at least 2012.

There is no legitimate justification for falling behind the IECC, let alone staying behind for multiple cycles. Construction in Virginia is not unusual or so distinctive as to justify its being so far behind the nationally recognized IECC promulgated by the ICC since 2012. Virginia law requires that the USBC protect "*the health, safety and welfare of residents in the Commonwealth*" and to be "*consistent with recognized standards of health, safety, energy conservation and water conservation*…."

Minimizing costs of construction is a goal but only to the extent the USBC protects the *"health, safety and welfare of residents"* and remains "*consistent with recognized standards of health, safety, energy conservation and water conservation*…" Home builders' desires to minimize their costs cannot justify undercutting recognized energy conservation standards, nor can they justify harming the "welfare of residents" who will bear decades of higher energy costs as a result of cutting efficiency corners at the outset.

The energy efficiency measures contained in the IECC should, therefore, be fully incorporated into the USBC for new construction and for rehabilitation of existing buildings. When the 2012 IECC was adopted, DOE calculated that implementing the new provisions would be cash positive for homebuyers from the first month and would soon recoup all the incremental construction costs.[9]

As proposed below, the BHCD should also go beyond the 2018 IECC to move Virginia closer to the efficiency levels of the forthcoming 2021 IECC or to other important efficiency standards established by the U.S. Building Council (LEED), EarthCraft, and other organizations. These are realistic standards and achieving higher levels of efficiency will benefit owners and

---

Climate Change and Fourth National Climate Assessment make clear that swift decarbonization and a transition to clean energy is required to meet the urgency of the challenge." In addition, as noted above, earlier this year, the Virginia General Assembly enacted and the Governor signed by the Virginia Clean Economy Act and Clean Energy and Community Flood Preparedness Act to address climate change through energy efficiency and other measures to reduce CO2 emissions.

[9] DOE, National Energy Cost Savings for New Single and Multifamily Homes, A Comparison of the 2006, 2009, and 2012 Editions of the IECC, https://www.energycodes.gov/sites/default/files/documents/NationalResidentialCostEffectiveness.pdf

renters for decades. It should also use its authority to eliminate some of the least efficient options.

2. Examples of Changes to the USBC that Need to be Incorporate the 2018 IECC

The following are some of the key changes needed to make the USBC consistent with the 2018 IECC, ICC's nationally recognized standards for energy conservation. This is not an exhaustive list.

It should be noted that to the extent efficiency shortfalls are most likely to occur in lower-cost construction, it is low and moderate income buyers or tenants who are most likely to be hurt by higher heating and cooling bills for the lifetimes of the structures. Since we know that each of these measures saves money and each is a small percentage of the cost of a new home, there is no good reason to perpetuate outdated, inefficient measures in the USBC.

a. **Building envelopes**.

As proposed in the February 3, 2020 Virginia Register, the Virginia's USBC for residential buildings would continue to incorporate building envelope standards that were included in the 2009 IECC (and possibly earlier codes). Those standards were superseded by the 2012, 2015 and 2018 IECCs, but were never adopted into Virginia's USBC.

Such outdated building envelope standards have no place in Virginia's USBC. They will harm residents, particularly low and moderate income residents, for decades with higher energy bills.

Based on information from the Responsible Energy Codes Alliance, adopting the 2018 standards for walls and ceilings would add approximately $614 to the construction cost of a new single-family home in Virginia but would save buyers or renters an average of more than $100 per year. The cost would be fully repaid in annual savings within 6 years (even at current energy costs), and the savings would continue for decades.

Wall Insulation. Like the 2012 and 2015 IECCs, the 2018 IECC would require that walls be constructed to meet standards of R.20 or R.15+5. That is substantially more insulation than the R.15 or R13+1 which the proposed rule would carry forward from the 2009 code. Wall insulation is particularly important both because it pays back quickly and because retrofitting insulation in the walls of a house would require major reconstruction.

Ceiling insulation. Like the 2012 and 2015 IECCs, the 2018 IECC would require ceilings in new dwellings to be insulated to R.49, not R.38 that the pending proposal would extend from the 2009 cycle. Adding ceiling insulation is low cost and saves money.

b. **Air Infiltration and Blower Door Testing**

It is very important to revise the air infiltration limitation down to 3 air changes per hour and to require blower door testing. The pending proposal would finally require blower door testing, but it would continue to allow 5 air changes per hour. That is not enough.

Reducing the maximum air infiltration to 3 air changes per hour was technically and economically established when the 2012 IECC was promulgated, and the IECC requirement has remained at 3 air changes per hour in both the 2015 and 2018 IECC. There is no excuse for Virginia to continue to permit leaky houses that require additional heating and cooling in order to offset the infiltration of outside air. That drives up utility costs for occupants and air pollution for all of Virginia from avoidable fossil fuel combustion. To the extent lower cost construction is most likely to avoid sealing leaks, it is low and moderate income buyers or tenants who are most likely to be hurt. There is no reason why builders, informed by blower door tests and other techniques (infrared cameras, for example), should not be able to identify and seal leaks to reduce infiltration to 3 air changes per hour.

3. Efficiency Standards Should Not Be Relaxed for Existing buildings

Virginia Code Section 36-99.01 recognizes the "urgent need to improve the housing conditions of low and moderate income individuals and families [and] to improve the existing condition of many of the Commonwealth's stock of commercial properties." Although it expresses concern that building codes have "sometimes led to the imposition of costly and time-consuming requirements that result in a significant reduction in the amount of rehabilitation activity taking place," it only directs the BHCD to *consider* the issue. It does not direct the BHCD to relax energy efficiency standards for rehabilitation of existing buildings, nor should the BHCD do so. Relaxing efficiency standards in rehabilitation projects will harm the very low and moderate income individuals and families that the legislation was intended to help.

Improving energy efficiency should be a critical element of any rehabilitation project.[10] Failing to meet IECC standards for renovating existing buildings will simply mean that buyers or renters will incur higher utility bills that exceed the cost of borrowing funds to pay for the efficiency measures. Before long, the lost savings to a buyer or tenant will exceed the costs that the builder avoided by failing to address the efficiency issues. It is neither in the customer's interest nor the public's interest to extend the lives of inefficient buildings. The code should be clear that energy efficiency standards are an important part of renovations of existing buildings and should not be waived by local officials.

For example, the proposal to delete R503.1.1.1 should be rejected. Window replacements should have U-Factors and SHGC factors that are equivalent to those the IECC would require for new buildings. In reality, most of the costs related to window replacements result from the decision to replace the windows in the first place – the difference between a code-compliant window and a noncompliant window is typically a very small incremental cost difference. Leaving no standard could result in considerable waste of energy going forward. Moreover, homeowners may believe that they are getting all the benefits of more efficient windows, but in the absence of a specific code requirement, they may not realize that

[10] ACEEE recently discussed the importance of accelerating efficiency retrofits of existing buildings in *Mandatory Building Performance Standards: A Key Policy for Achieving Climate Goals* (2020), https://www.aceee.org/sites/default/files/pdfs/buildings_standards_6.22.2020_0.pdf

replacement windows do not meet the same U-factors or SHGCs that would be required for new construction.

Beyond that alterations to the building should generally follow the requirements for new buildings when new materials are installed. At a minimum, for example, when walls are opened, wall insulation should be maximized for the available space. When there is access to a ceiling, more insulation should be added. (When appliances are replaced, builders should be incentivized to the extent possible to install high-efficiency appliances, preferably Energy Star.) Central heating systems that rely on electric resistance heat should be replaced with more efficient heat pumps. These types of requirements should be consistently enforced by building inspectors.

4. Additional Requirements for New Buildings

As discussed below, the BHCD should be taking all reasonable steps to reduce energy consumption in buildings, including going beyond the 2018 IECC. It should also be taking steps to prepare new buildings to be able to meet the growing demand for electric vehicle charging. Buildings undergoing major renovations should also meet these requirements.

a. Builders Should be Required to Choose an *Additional Measure* From a List of Energy-Saving Options

New construction presents the opportunity to incorporate additional measures to reduce energy usage. We urge the BHCD to require builders of new residential buildings to adopt at least one of the following measures in addition to all of the mandatory efficiency measures in the 2018 IECC. These recommendations are all based upon provisions we expect to see in the 2021 IECC, which we anticipate will be finalized before the BHCD issues a final rule in this proceeding.

1. **Better insulation**. Meet the wall and ceiling insulation requirements equal to or better than R.20+5 or R13+10 for walls and R. 60 for ceilings, which are expected to be in the forthcoming 2021 IECC for Climate Zone 4;
2. **Better ERI**. Meet the expected 2021 IECC baseline ERI of 54 for Climate Zone 4;
3. **More efficient HVAC**. Install heating and cooling equipment that meets or exceeds one of the following:
    a. Greater than or equal to 95 AFUE natural gas furnace and 16 SEER air conditioner
    b. Greater than or equal to 10 HSPF / 16 SEER air source heat pump
    c. Greater than or equal to 3.5 COP ground source heat pump.

    For multiple cooling systems, all systems shall meet or exceed the minimum efficiency requirements in this section and shall be sized to serve 100% of the cooling design load. For multiple heating systems, all systems shall meet or exceed the minimum efficiency requirements in this section and shall be sized to serve 100% of the heating design load.

4. **Reduced energy service use in service water heating option**. The hot water system shall meet or exceed one of the following efficiencies:
    a. Greater than or equal to 82 EF fossil fuel service water heating system;
    b. Greater than or equal to 2.0 EF electric service water heating system;
    c. Greater than or equal to 0.4 Solar Fraction solar water heating system.

b. BHCD Should Use its Authority to Prohibit Certain Forms of Heating in New Residences

In addition to its other authorities to regulate building construction, Section 36-99.6:3 of the Virginia Code states:

> "**Regulation of HVAC facilities**. The Board shall promulgate regulations in accordance with the Administrative Process Act (§ 2.2-4000 et seq.) establishing standards for heating, ventilation, and air conditioning (HVAC) facilities in new, privately owned residential dwellings."

a. Resistance Space Heating. The BHCD should use that authority to prohibit installation of electric resistance space heating (baseboard or electric furnace) in new residential dwellings of all sizes. Electric resistance is very inefficient compared to electric heat pumps, including mini-splits. Indeed, electric heat pumps have 3-4 times the energy efficiency of resistance heat. Resistance heat increases user costs, air pollution and peak utility demands. It is cheap to install but very expensive to operate and environmentally harmful.

Georgia has adopted mandatory building code provisions (R403.1.2) that (**a) prohibit resistance heat as a primary source of heat in new dwelling units or as replacements for heat pumps in existing units, and (b) require that operation of resistance heating elements in heat pumps be restricted to periods when heat from the heat pump is inadequate. This is a reasonable solution, which Virginia should adopt.**

Consequently, the USBC should be amended to bar the use of resistance heat except as a supplement to an electric heat pump during very cold periods. Central heat pumps include resistance heat and mini-splits do not. Both central heat pumps and mini-splits will save money for customers and minimize the use of baseboard resistance heating. With a highly efficient electric heating technology available, the least efficient form of electric heat should be prohibited.

b. Gas Furnaces. The Board should also use its authority, under 36-99.6.3, to prohibit future installations of gas furnaces in new, privately owned residential dwellings. Combustion of gas in the home compounds carbon emissions harmful to the planet and contributes to indoor air pollution that go beyond carbon dioxide. Methane emissions associated with natural gas at every stage from production to consumption also increase climate change, particularly since methane is approximately 86 times more potent than

carbon dioxide as a heat-trapping gas, over 20 years.[11] In contrast, high efficiency electric heat pumps, which will increasingly be powered by zero-carbon solar and wind generation, are more energy efficient, will reduce carbon pollution and avoid indoor air pollution that results from combusting or leaking natural gas.[12] The growing climate crisis and the importance of reducing indoor air pollution warrant implementation of this limitation on new natural gas furnaces.

c. Virginia's USBC Should Require Electric Readiness

Gas appliances – space heating, water heating and stoves – are significant sources of carbon pollution and unhealthy indoor air pollution. Ideally, builders would transition *now* to all-electric alternatives. However, **at a minimum, new dwellings should be wired so that homeowners can make cost-effective choices to switch to electric appliances, in the future.** That can be done at minimal incremental cost when walls are open and the electrical "bones" of a house are being installed, including wiring to serve all types of appliances.

Appropriate language can be found in Proposal RE147-19 (IRC N1104,2-N1104.2.3) which was adopted in the course of approving the 2021 IECC, which is now in its final phases. Adopting such a requirement will protect homeowners' health and welfare by preserving their options to switch to electric appliances either by choice or because natural gas appliances are eventually phased out due to pollution or other factors. It will protect the Commonwealth by encouraging future reductions of indoor and outdoor pollution.

d. Solar Readiness

The BHCD should move ahead with provisions requiring solar readiness in construction of new single-family dwellings and townhouses. As Governor Northam recognized in EO43, clean energy sources need to be developed for the benefit of the Commonwealth. Rooftops present an excellent opportunity for installing solar panels. However, homeowners' chances of installing solar PV panels or solar water heating will be diminished if a house is poorly oriented to the sun or lacks roof strength or other basic preparations (*e.g.*, electrical conduits). Even without requiring installation of solar energy facilities, the BHCD should at least provide for solar readiness in detached single family and townhouses to the extent feasible. **Appropriate language can be found in the 2018 IECC appendix dealing with solar readiness.** https://codes.iccsafe.org/content/iecc2018/appendix-ra-solar-ready-provisions-detached-one-and-two-family-dwellings-and-townhouses .

---

[11] "The drilling and extraction of the fuel from wells, as well as its processing, transmission, distribution, and storage, also result in the leakage of methane—a primary component of natural gas that is 34 times stronger than carbon dioxide at trapping heat over a 100-year period and 86 times stronger over 20 years (Myhre et al. 2013)." Union of Concerned Scientists, The Natural Gas Gamble: A Risky Bet on America's Clean Energy Future (March 2015), p. 16. The report adds: "Although there is still uncertainty about the precise quantity of these so-called fugitive methane emissions, preliminary studies and field measurements range from 1 to 9 percent of total natural gas production.

[12] Indirectly, installing a natural gas furnace will increase the probability that a gas stove will be installed. Gas stoves are a particularly large source of indoor air pollution. https://rmi.org/insight/gas-stoves-pollution-health ;

e. Electric Vehicle Charging Capabilities

Electric vehicles (EVs) are growing in importance and will continue to grow in importance as climate risks compel shifting to vehicles that do not emit pollution. Vehicles are Virginia's largest source of carbon-dioxide emissions from fossil fuel combustion.[13] Those emissions would be substantially reduced by switching to EVs, and the emissions associated with EVs will decline more as zero-carbon renewable energy replaces fossil-fuel generation. *Even based on today's mix of generation in Virginia, DOE estimates that EVs would reduce CO2 emissions by roughly two-thirds compared to vehicles combusting gasoline*.[14] Furthermore, EV electricity charging during off-peak periods can lead to a reduction of rates to all consumers.[15]

Forecasts of EV growth are substantial over the next 10 years and beyond with the Edison Electric Industry estimating that more than 20% of new vehicle sales will be EVs by 2030, and other estimates go as high as 33% by 2030.[16] At-home charging in conjunction with single or multifamily parking is particularly important to meeting the needs of EV owners and to encourage charging during overnight periods rather than during utilities' peak demand periods.[17] Charging EVs is generally slower than pumping gasoline or diesel vehicles, and the public infrastructure for charging is still very limited. At-home charging resolves both of those difficulties.

Experience shows that installing a simple 220V/40 Ampere outlet (comparable to a dryer outlet) in a garage will enable an EV owner to conveniently schedule battery charging at night or otherwise outside the utilities peak demand period. (The presence of the wiring would permit low-cost installation of a different charging system in the future.)

While it is easy to install the wires, panel capacity and conduits for electric vehicle charging—along with the rest of a dwelling's wiring--when a single or multifamily dwelling is built, it is much harder and much more expensive to do so as a retrofit.[18]

---

[13] https://www.epa.gov/sites/production/files/2019-11/documents/co2ffc_2017.pdf

[14] DOE estimates that an EV in Virginia emits (via electric generation) less than a third as much CO2 as a gasoline-driven vehicle. https://afdc.energy.gov/vehicles/electric_emissions.html ; https://evtool.ucsusa.org/

[15] See June 23 Comments of the Sierra Club to the State Corporation Commission in Docket PUR-2020-00051, Electrification of Motor Vehicles. As the comments explain, with managed off-peak charging and rates, rising EV loads can drive down rates to all customers.

[16] https://www.edisonfoundation.net/-/media/Files/IEI/publications/IEI_EEI-EV-Forecast-Report_Nov2018.ashx ; June 23 Comments of the Sierra Club, note 15, supra. The Sierra Club also notes the figures could be much higher with appropriate policies.

[17] Utilities' energy sales are lowest and cheapest in off-peak hours, particularly at night. One strategy is to design time-of-use rates with low night-time prices to encourage off-peak EV charging. For EV customers to make use of such incentives, they will need access to overnight charging at home where they spend the night.

[18] In submissions to the IECC as part of the 2021 IECC process, data indicated that the cost of retrofitting commercial parking to EV ready status would be 3-8 times higher than doing to work at the time of building construction. See Proposed CE217-19 Part 1.(Cost Impact discussion). The submission's statement of reasons also documented the large increases projected for the number of EVs expected to be on the road, rising from 1 million

Accordingly, we urge the BHCD to require installation of EV charging capabilities and readiness when new single-family and multi-family residences--including high-rise residential classified as "commercial" in the building code--are constructed. At that point the initial costs are low, but an owner or tenant will not be inhibited from buying an EV due to uncertainty about the availability of charging.

It would also be desirable to require EV charging capabilities and readiness for non-residential commercial parking areas. This is particularly important for people who do not have and, in some cases, cannot install EV charging at home (*e.g.*, because they only have street parking). Again, incorporating the infrastructure into new commercial buildings can be achievable at a lower cost if it is done at the outset.

Attached as Appendix B is our proposal to require minimum levels of EV charging in new single family and multifamily residential construction that includes parking (garage or outdoor). This requirement should be applied to multifamily construction classified as commercial, as well as low-rise multifamily. The language in Appendix B is based upon language in the near-final 2021 IECC (CE217-19 Parts 1 and II), which also has parallel language for EV charging in the commercial code which should be used at least for multifamily construction under the commercial code. While we support the idea of requiring EV charging capabilities in all commercial buildings, our proposal hear is limited to residential dwellings, including low-rise and high-rise multifamily dwellings. It is based on our understanding of what has been included so far in the 2021 IECC. As long as it is adopted, we would not object to it being incorporated into another portion of the 2021 ICC (e.g., possibly electrical or mechanical).

f. Zero Energy Residential Buildings Option

The Board should adopt a zero-energy option for builders, which would allow them to advertise a net-zero energy dwelling if implemented and which would provide a more uniform set of net-zero-energy provisions that could be applied across the Commonwealth. **As incorporated into the nearly final 2021 IECC, Proposal RE223-19 would add an appendix that would define the central elements of "Zero Energy Residential Buildings." In brief, a residential structure would qualify, in Climate Zone 4, if it achieves a Energy Rating Index (ERI) score, calculated pursuant to RESNET/ICC301), of equal to or less than 47 not including onsite power production and a score of 0 including onsite power production.**

Creating this option may incentivize builders to meet those goals so they can advertise zero energy construction. That information could benefit interested buyers as well as builders.

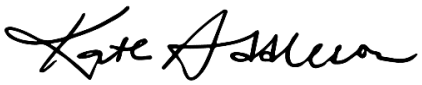
C. Conclusion

In summary, we strongly urge the BHCD to adopt final rules for a revised building code that (1) contains all of the provisions of the 2018 IECC for new construction and for rehabilitation of existing buildings; (2) exceeds the efficiency requirements of the IECC in certain important

at the end of 2018 to 18.7 million by 2030. Every major carmaker has announced plans for significant EV production increases over then next 5 years.

respects, and (3) adds a requirement for solar readiness and EV charging capabilities and readiness and an option for zero energy construction.

Respectfully submitted,



Kate Addleson, Director
William Penniman, Sustainability Chair

Virginia Chapter of the Sierra Club
100 W Franklin St, Mezzanine
Richmond, VA 23220
Phone: 804-225-9113

Eric Goplerud, Chair
Faith Alliance for Climate Solutions

Jo Anne St. Clair, Chair
Climate Action Alliance of the Valley

June 25, 2020

APPENDIX A - DESCRIPTIONS OF COMMENTING PARTIES

The Virginia Chapter of the Sierra Club has over 19,000 members. The Sierra Club is a non-profit, membership organization dedicated to exploring, enjoying and protecting wild places; to promoting the responsible use of the Earth's resources and ecosystems; to educating and enlisting humanity to protect and restore the quality of the natural and human environment; and to using all lawful means to carry out those objectives.

The Faith Alliance for Climate Solutions is a non-profit organization with more than 75 faith communities and 2,400 faith-based activists in Northern Virginia whose mission is to develop local solutions to climate change.

Climate Action Alliance of the Valley (CAAV) is an organization of residents of the Shenandoah Valley. CAAV's mission is to limit the impact of humans on Earth's climate and minimize the effects of inevitable climate change in order to protect the future for Earth and its inhabitants. The vision of CAAV is to create and nurture climate action in our Shenandoah Valley community so that we can become a regional leader in promoting climate change mitigation and resilience. CAAV seeks to achieve policies and legislation that advances the systemic changes required to promote climate stabilization and resilience.

APPENDIX B
PROPOSED ADDITION TO ADDRESS RESIDENTIAL EV CHARGING IN NEW SINGLE AND MULTIFAMILY RESIDENTIAL CONSTRUCTION

Section R202 (IRC N1101.6)
General Definitions

Electric Vehicle Supply Equipment (EVSEL). The conductors, including the ungrounded, grounded, and equipment grounding conductors, and the Electric Vehicle connectors, attachment plugs and all other fittings devices, power outlets or apparatus installed specifically for the purpose of transferring energy between the premises wiring and the Electric Vehicle.

EV Capable Space. Electric panel capacity and space to support a minimum 40-ampere, 208/240-volt branch circuit for each EV parking space, and the installation of raceways, both underground and surface mounted, to support the EVSE.

EV Ready Space. A designated parking space which is provided with one 40-ampere, 208/240-volt branch circuit for EVSE servicing Electric Vehicles. The circuit shall terminate in a suitable termination point such a s receptacle, junction box, or an EVSE, and be located in close proximity to the proposed location of an EV parking spaces.

R404.2 (IRC N1104.2) Electric Vehicle (EV) charging for new construction. New construction shall facilitate future installation and use of Electric Vehicle Supply Equipment (EVSE) in accordance with the NFPA 70.

R404.2 (IRC N1104.2.1) New Residential Buildings. One-to two-family dwellings and townhouses. For each dwelling unit for which parking is provided, provide at least one EV Ready Space. The branch circuit shall be identified as "EV Ready" in the service panel or subpanel directory, and the termination location shall be marked as "EV Ready.

R402.2.2 (IRC N1104.2.2) Multifamily Dwellings (three or more units). EV Ready Spaces and EV Capable Spaces shall be provided in accordance with Table R404.2.2. Where the calculation of a percent served results in a fractional parking space, it shall be rounded up to the next whole number. The service panel or subpanel circuit directory shall identify the spaces reserved to support EV charging as "EV Capable" or "EV Ready". The raceway location shall be permanently and visibly marked "EV Capable".

Table R404.2.2 (IRC N1104.2.2)
EV Ready Space and EV Capable Space Requirements

Total Number of Parking Spaces	Minimum number of EV Ready Spaces	Minimum Number of EV Capable Spaces
1	1	
2-10	2	
11-15	2	3
16-19	2	4
21-25	2	5
26+	2	20% of total parking spaces

313 East Broad Street, Suite 212
Richmond, VA 23219

Erik Johnston, Director
Department of Housing and Community Development
600 East Main Street, Suite 300
Richmond, VA 23219

April 2, 2020

Dear Erik:

On behalf of the Virginia Energy Efficiency Council (VAEEC), I am writing in support of the draft Uniform Statewide Building Code (USBC). The draft USBC is the culmination of discussions among various stakeholders, including energy efficiency advocates, homebuilders, code officials and fire officials, under the guidance of the Department of Housing and Community Development.

The VAEEC and our members have been actively engaged in this process over the last several cycles. As the voice for the energy efficiency industry in the Commonwealth, our goal is to ensure that energy efficiency is an integral part of Virginia's economy. In partnership with over 100 members, which include fortune 500 companies, small businesses, nonprofits, local governments, state agencies, utilities and individuals, we are working to assess and support programs and policies that advance Virginia's energy efficiency industry.

In short, the VAEEC knows that investments in energy efficiency mean new jobs in every corner of Virginia. And we have built a lot of momentum in recent years. Recent reports indicate that energy efficiency is the leading sector of the clean energy industry, supporting approximately 78,000 jobs. Greater investments and growth in energy efficiency means more jobs in the local communities - jobs that cannot be outsourced.

Incorporating strong energy efficiency measures in the USBC is one such policy. In the last code update cycle, we were able to successfully push for the inclusion of the rigorous energy efficiency measures into the final USBC, such as reducing the allowable leakage of air from newly-installed air ductwork, and requiring mechanical- or duct-blaster- testing to measure that leakage. The current draft USBC builds on that momentum with additional key efficiency measures, including: blower door testing requirements for all new homes, increased efficiency requirements for new windows, allowing the use of DOE software to ensure compliance with state energy codes, and requiring a certificate on the electrical box that includes energy details of the home, which will help with future HVAC replacement when needed.

The blower door testing requirement is a big step in the right direction. According to a DOE Field Study conducted by Viridiant, in conjunction with the Southeast Energy Efficiency Alliance, 25% of new homes are failing to meet the current air leakage requirements in the USBC. Every newly-built home in Virginia should meet the minimum code standards set forth in the USBC, and mandatory blower door testing will help achieve that.

While we are pleased to see increased efficiency measures incorporated into the draft regulations, there is still work to be done to incorporate all efficiency measures from the international model code in the final USBC. For example, increased insulation requirements for ceilings and walls have been part of the international model code since 2012 and is the single largest efficiency gain of any one proposal. Based on analysis from the Responsible Energy

313 East Broad Street, Suite 212
Richmond, VA 23219

Codes Alliance, homeowners will benefit from roughly $78-$103 annual energy cost savings from increased insulation requirements as compared to a home built to Virginia's current energy code. However, Virginia continues to require less efficient insulation requirements for walls and ceilings. VAEEC members have been holding information sessions throughout Virginia with homebuilders to help them better understand what would be required with an increase in the insulation R-value. We hope to see some improvements to the insulation requirements in the final USBC.

Increased energy efficiency requirements in the USBC means more homes are being built with enhanced cost-saving benefits, which is something everyone should be able to support.

Respectfully,

Chelsea Harnish
Executive Director

COMMONWEALTH OF VIRGINIA

HOUSE OF DELEGATES
RICHMOND

RICHARD C. (RIP) SULLIVAN, JR.
MAJORITY CAUCUS CHAIR

POST OFFICE BOX 50753
ARLINGTON, VIRGINIA 22205

FORTY-EIGHTH DISTRICT

COMMITTEE ASSIGNMENTS:
LABOR AND COMMERCE (VICE CHAIR)
FINANCE
COURTS OF JUSTICE
RULES

Chairman Steve Semones
Department of Housing and Community Development
Board of Housing and Community Development
600 East Main Street, Suite 300
Richmond, VA 23219

June 25, 2020

Dear Chairman Semones:

I write today in support of updating Virginia's residential building code with strong energy efficiency standards that reflect the urgent economic and environmental need to promote energy efficiency. I understand that the Board of Housing and Community Development (BHCD) is considering merely continuing current standards instead of modernizing them, and I encourage the Board to choose the latter option and help bring Virginia from the back to the front of the pack on energy efficiency.

As the House patron of the Virginia Clean Economy Act (VCEA), which created the Commonwealth's first energy efficiency resource standard for utilities, I collaborated with industry stakeholders, activists, constituents, and my fellow lawmakers on this important issue. Our work proved that there is clear bipartisan support in the General Assembly for ambitious energy efficiency standards and programs – it is the fastest, cheapest way to reduce energy bills and reduce carbon emissions. The VCEA made great strides on energy efficiency, but we have to do more if we are to maximize this important energy-saving tool in Virginia.

I urge the Board to adopt, at a minimum, the International Energy Conservation Code's (IECC) 2018 standards for all USBC-covered forms of construction. The Board should reject using the IECC's 2009 standards, which fail to reflect the technological advances of the last decade and do not meet the popular demand for strong energy efficiency requirements.

Thank you for your consideration, and I am ready to answer any questions that you may have.

Best,

Delegate Rip Sullivan
48th District of Virginia

Commenter: Andrew Grigsby

It's time to bring Virginia into compliance with the 2012 IECC efficiency standards

My comments refer to the energy efficiency standards of the USBC. I urge the Board to adopt the 2018 International Energy Conservation Code (IECC) wholesale, without alteration. The Virginia amendments that weaken our residential energy code relative to the IECC increase the total cost of housing (when considering mortgage payments plus energy costs) and should be abandoned.

The current draft update to the USBC fails to bring Virginia into compliance with key provisions of the 2012 IECC. Virginians still are not enjoying the cost savings, improved comfort, resiliency benefits, and improved indoor air quality that the IECC adopted 9 years ago. The deficiencies compared to the 2012 IECC that persist in the current draft 2018 USBC include

- Whole-building air leakage limit: in 2012, the IECC adopted 3ACH. Virginia adopted 5ACH and remains there now. (I applaud the inclusion of mandatory mechanical testing of air leakage that is included in this draft. The 5ACH standard in place the last few years has been unenforceable without a mechanical test.)
- Duct leakage threshold: the IECC adopted 4% in 2012. Virginia adopted 6% and remains there now.
- Exterior wall insulation: in 2012, the IECC standard increased from R13 to R20/13+5 (cavity/cavity+continuous). Virginia went to R5/13+1 in 2012 and remains there now.
- Attic insulation: the IECC adopted R49 as the cost-effective standard for this climate zone in 2012. Virginia remains at R38.

In 2012, the US Dept. of Energy calculated that, compared with the 2009 Virginia USBC, "life-cycle cost savings, averaged across building types, are $5,836 for the 2012 IECC," and that the "simple payback period is 5.2 years for the 2012 IECC," with positive cash-flow in year 1 of homeownership (see www.energycodes.gov/sites/default/files/documents/VirginiaResidentialCostEffectiveness.pdf). The 2015 IECC update included very modest changes that, compared to the 2012 IECC, obtained $101 in life-cycle cost savings with simple payback in less than 1 year in Virginia's climate zone (see www.energycodes.gov/sites/default/files/documents/VirginiaResidentialCostEffectiveness_2015.pdf).

Virginia's residential energy code has been improved since 2009, but critical elements still are left out. The simplest thing is to use the unadulterated IECC. This has the added benefit of providing uniformity across state lines, which obtains further process efficiency for many builders.

Rigorous energy codes are a win for

- energy resource planning (costs, grid stability, predictability)
- environmental policy (climate change, resource use)
- the construction industry (increase value and quality of their product, more jobs)
- the mortgage industry (32% less risk of default: see the IMT/UNC report at www.imt.org/resources/home-energy-efficiency-and-mortgage-risks/)
- local jobs (framing and insulating don't happen overseas, testing is new work, quality takes time)
- housing affordability (increases predictability of monthly costs and lowers total cost of housing)
- home buyers/renters of all kinds (comfort, savings, predictability, indoor air quality)

Besides, people want it. A 2013 survey by the National Association of Homebuilders reports that 9 out of 10 homebuyers are willing to pay 2-3% more for a home that includes permanent energy efficiency features.

In 2020, we should not be building new homes that will need major retrofitting to comport with the clean energy goals, social cost of carbon, focus on resiliency, etc. that are now driving Virginia policy and regulation. The cheapest time to make a building energy efficient is during construction or major renovation. That is how to provide the maximum comfort and cost benefits to Virginia residents. In 2020, Virginia should, at the very least, bring our residential energy code into compliance with provisions of the IECC that have been in effect since 2012. This is the true path to affordable housing: reducing the total cost of homeownership.

As the 2018 code update cycle is completed this year, I urge the Board of Housing and Community Development to adopt proposals that bring Virginia into full compliance with the current IECC.

CommentID: 79342

3/2/20 1:37 pm

Commenter: Andrew Grigsby

Correction to earlier comment: Virginia already at 4% duct leakage

My previous earlier comment included an inaccurate statement. Virginia already has a 4% leakage threshold for residential duct systems - which aligns with the current IECC - not 6% as I stated earlier.

CommentID: 79399

6/23/20 9:30 am

Commenter: James Robb

Purchase cost vs operating cost of a home

I purchased a home in Richmond, Virginia that was built in 1938. The home had NO insulation in the walls, floor, or perimeter of the foundation. Single pane windows with leaky sash tracks were the standard. The ceiling had just 4" of rock wool. In the wintertime, you could feel the cold air blow across your feet as the air changed regularly in the home. This was the standard for 1938.

There is no reason not to follow the Virginia Law mandated IECC national standard when it comes to reviewing code changes in Virginia.

The cost of purchasing an energy-efficient home is quickly offset by the savings in monthly utility bills. The comfort of the home is why we have homes, to begin with. Quality of installation, materials, and practices can help save energy over the life of the mortgage AND the life of the home, adding real value to the homeowner who can boast to the energy efficiency to the next purchaser.

A builder's job is to build a quality home. A good builder's job is to build a quality, energy-efficient home, built to the best science, common sense, and reasonable cost. This good builder can market efficiency as a bonus, not as an added cost. The bust builder would build an energy-efficient home he/she would be proud to live in, and in fact, does live in.

You have a chance here to correct the code to bring affordable living to more people, by not just considering what a home costs to build, but what it costs to own and operate. Lower utility bills mean more money for the homeowner to participate in a wider economy.

CommentID: 83797

6/23/20 10:59 am

Commenter: Peter Braun

Building Codes should follow International Energy Conservation Code (IECC)

Virginia building codes should not remain outdated and inefficient. Do not continue old policies that cut corners and ignore best practices that reduce costs to Virginians and to the environment. The most up-to-date versions of International Energy Conservation Code (IECC) should be adopted, or even more ambitious building codes.

My family has to pay for the energy we use. The buildings of today will stick around for a long time and place an undue burden on families, especially low-income families, who already share a disproportionate energy cost burden in Virginia. Update the building codes to be leading, protect our environment, and not fall behind.

There is a lot at stake beyond a monthly bill for an average family. As Virginia is decades behind on clean energy, energy efficiency, and climate action, there is no time to wait to adopt new policies that change the way we do business. Energy efficiency is a commitment to our own collective future.

As an Environmental Studies student at the University of Richmond with a focus on sustainability and equitable climate action, I support the implementation of IECC and even more ambitious standards such as Earth Craft or Passive House standards.

CommentID: 83798

6/23/20 12:08 pm

Commenter: William Driscoll

A stronger building energy efficiency code will save residents money and save the climate

A stronger building energy efficiency code will save residents money and save the climate.

Please adopt the most recent IECC building energy efficiency code for Virginia housing and other buildings.

Sincerely,

William Driscoll

Arlington, VA

CommentID: 83800

6/23/20 2:35 pm

Commenter: Joanna Vereen

Don't be outdated

Virginia should, at the very least, require adherence to the most recent IECC standards. The environmental and long-term financial implications require it.

CommentID: 83801

6/24/20 8:23 am

Commenter: Barbara Foster

Stricter Building Codes save residents money

Houses built to the highest efficiency standards save far more money on energy over time than they add to the upfront cost of the house. Our environment cannot wait for efficiency standards to raise.

CommentID: 83804

6/24/20 11:38 am

Commenter: Jennifer Bears

Virginia's need to update outdated building efficiency standards

To whom it may concern,

Each time I see a house being torn down and a new inefficient house being built in my neighborhood, I ask myself the question:

Why is Fairfax County allowing houses be built that are not only expensive to heat and cool but definitely not addressing health, safety, energy and water conservation necessary to "build" a better world. These houses are not in line with the IECC. Building energy efficient houses are absolutely necessary in order to ensure that future generations have a high standard of living instead of a world that will be uninhabitable. We should be leading the way in adopting energy efficient housing. It is unacceptable that a highly educated, wealthy county such as Fairfax would be so out of touch with the realities of the demise of our planet because people are putting profit ahead of the health and well being of our environment. Future generations will curse you if you do not "get with the program" and start taking the environmental crisis seriously.

Please stop allowing builders to tear down the trees. Trees are one of the best ways to fight pollution. Some countries are planting trees to stop pollution.

Best

Jennifer Bears

CommentID: 83805

6/24/20 12:08 pm

Commenter: Judy Gayer

It's time to require greater energy efficiency and help address the climate crisis

Thank you for providing this opportunity to comment on this important issue.

The Board should adopt the energy-saving provisions of the latest International Energy Conservation Code (IECC). The Board's current proposal ignores the critical need for all sectors to become more energy efficient to avert the direst consequences of climate change. Furthermore, the Board's proposal is inconsistent with Virginia law, which requires the Board to adopt provisions that permit buildings to be constructed at least possible cost *"**consistent with recognized standards of health, safety, energy conservation and water conservation***." Virginia code suggests that building regulations may go beyond the IECC for purposes of health and safety, but ***should not fall short of its standards***, as the Board is now proposing to do.

Although requiring energy efficiency may increase builders' up-front investment costs (at least for now), research has demonstrated that buildings constructed to the highest efficiency standards ***save more money on energy over time*** than they add to the upfront cost. This is true

even if we don't take important externalities into account, such as the long-term cost to the environment of continuing to allow energy-inefficient building practices.

The climate crisis creates an imperative that we use building codes to reduce our consumption of fossil fuels. Ralph Northam recently made it clear in Executive Order 43 that Virginia is committed to a path of clean energy and energy efficiency. Buildings represent an enormous portion of all energy use and are a major contributor to climate change. Requiring builders to build homes that produce their own energy is a key part of any plan to address the climate crisis.

Thank you for considering my comments.

CommentID: 83806

6/24/20 2:36 pm

Commenter: John Wise

Residentail Building Code Update

Please consider strengthening the Virginia building code by including applicable higher energy and air quality standards that may be found in the International Energy Conservation Code. The USBC does not adequately address some of the low cost measures in the IECC that would help with energy conservation, greenhouse gas emissions and long term energy cost savings for homeowners.

CommentID: 83808

6/25/20 12:18 pm

Commenter: Adam Siegel

Virginia is Inefficient: DHCD should do something about this

A simple truth: the Commonwealth of Virginia (its businesses, its citizens, its built environment, …) is an energy hog with mediocre (perhaps even dismal) energy efficiency.

- The American Council for an Energy Efficient Economy (ACEEE) ranked Virginia 29th in the nation.
- According to WalletHub, Virginia's Home Energy Efficiency Rank is 35th … out of 48 assessed states.

Simple truths behind those numbers are one of the reasons why legislators made sure to include substantial energy-efficiency measures in the Clean Economy Act (VCEA). While the VCEA sets a better path forward, it isn't comprehensive across all the economy and its measures don't relieve other parties' responsibilities for acting responsibly in the interest of the Commonwealth and its Citizens.

So much that matters in our lives is shaped out of sight, out of mind for most of us. When boarding a plane, we assume that the plane's design has been improved and there are inspectors out there making sure it's safe to fly. The same is true with so much throughout our lives — from washing machines to automobiles to elevators to … Well-managed standards and regulations are critical to our ability to function in the complex reality of modern society.

This is certainly true when it comes to buildings — standards and regulations lay a minimum basis for what will be around for decades to come. From structural soundness to fire safety to electrical wiring to energy efficiency, quality building codes are key to a quality built environment. And, as per energy efficiency, since buildings account for roughly 40% of energy use and the buildings will last for decades — poor energy efficiency codes translates to decades of wasteful energy use with higher bills and higher pollution loads.

One reason for Virginia's poor energy efficiency rankings: a long history of lagging behind the curve when it comes to International Energy Conservation Code (IECC). Currently, Virginia's code is based on the 2015

IECC (not the 2018) with critical portions of Virginia code dating back to the 2012 code and even the 2009 code. A decade is, in today's world, an eternity when it comes to energy efficiency and technologies. Just a few examples for an understanding:

- In 2009, the extremely efficient LED lights were an expensive and rare luxury while they are the norm in building today.
- In 2009, induction stove-tops were incredibly expensive (many $1000s) and hard-to-find while one can buy portable induction stovetops for under $50 online today and have them at your house tomorrow.
- In 2009, home owners had few options for managing their hot water heaters while today Virginia small business Aquanta offers a "retrofittable water heater controller brings your electric or gas water heater out of the basement and into the palm of your hand to heat water only when you need it."

The idea of having a building code in the 2020s based on over 10-year-old technologies and processes is ludicrous.

It appears that DHCD might, rather than simply upgrading to the latest IECC (2018), will simply continue many of the outdated elements of the existing code. (For a useful overlapping/reinforcing perspective, see Ivy Main's eloquent discussion.) Among those is to keep Virginia on the 2009 insulation standard rather than moving up something closer to present day standards. Regretfully, there are special interests (e.g., builders) who are perfectly willing to lower their costs for higher profits while delivering a lower-quality and higher-cost product to people for decades to come. The DHCD, it seems from the bleachers, has given builders and contractors a leading voice (role might not be too strong a word) in structuring Virginia's building code. The DHCD's approach to the IECC appears to be 'explain why we should upgrade' rather than 'make the case why we shouldn't'. This facilitates putting energy efficiency on the back burner. Quite simply: this is unacceptable.

This isn't 'just about climate' but quite clearly about acting in the best interests of Virginia's citizens and communities. For example, as Andrew Grigsby thoughtfully makes clear in his comment, advancing to current insulation standards has a rapid (perhaps 5 years) payback and would save an average home owner more than $5000. Energy efficiency investments are 'no brainers' that, sadly, few home purchasers really have a say about: it's all about the code.

With that in mind, some thoughts for DHCD:

- adopt the 2018 code essentially in entirety, especially when it comes to insulation.
- set (as per law) standard practice to adopt the most up-to-date codess the norm — with active decision-making to not adopt require.
- set a path to accelerate code updating so that 2021 IECC becomes Virginia code in 2022 (rather than 2024 or so)
- require up-to-date standards for building renovations and rehabilitation (especially in rental stock)
- work to identify paths for moving Virginia past the IECC (with elements from, for example, Net Zero) for improved building performance with lowered pollution loads and lowered costs.

In summary, DHCD should recognize that aggressive energy efficiency measures are in the public interest (from improved energy resiliency to reduced energy costs to reduced climate impacts) *and* that the legislature and the Governor have made clear that energy efficiency and climate mitigation are important for the Commonwealth. By adopting the 2018 building code and not keeping insulation at 2009 standards, the DHCD could demonstrate that recognition.

CommentID: 83809

6/25/20 5:10 pm

Commenter: Ross Shearer

Weakened amendments of the USBC's residential energy provisions are a social justice concern

Members
Board of Housing and Community Development
Public Meeting June 26, 2020
Commonwealth of Virginia

Dear Members of the Board:

I am communicating to ask each member to personally give attention this year to the current status of the residential energy requirements in Virginia's Uniform Statewide Building Code (USBC). The consequences of its current weakening amendments to the energy-conserving model developed by the International Code Council (ICC) is an emerging social justice issue. Additional delays will serve to inflate the inequity. Please prepare to adopt all of the cost-effective energy efficiency and conservations provisions into the USBC free of the current array of weakening amendments.

In the meantime, your approval to remove the visible inspection alternative to the blower door test is a significant development and much appreciated. Two substantial shortfalls remain, wall and attic insulation levels, as well as other weakening provisions. Given the multitude of challenges we face in moving towards a low to zero carbon future, Virginia should be promoting one of the easiest paths to reach its goal of a low carbon energy future by accelerating our transition to net zero and net zero-ready construction and major renovation. Stronger efficiency measures will bring many improvements to houses and protect the communities where they are built. All Virginians deserve this protection.

Let me briefly describe the civil equity issue I see emerging from Virginia's deferring full adoption of the ICC model. The failure to fully adopt the model, unamended, increases the financial burden of vulnerable low- and moderate-income Virginians who are disproportionately people of color. Builders often incorporate upper scale features including higher than code energy efficiency measures as part of a premium upgrade or through a builder's participation in a green program such as Energy Star or Earth Craft House. Basic low-cost, new construction built to but meet the code's outdated energy efficiency requirements yields a shortened life cycle for the structure, thus weakening its long-term market value. When such a house is planned and built today using criteria that has been out of date for close to a decade, the house is planned and built to become obsolete prematurely. The inequity issue becomes more evident when houses with built-in energy obsolescence are marketed and sold to entry-level, first-time buyers and the elderly. These demographic groups are disproportionately low-income, fixed-income and people of color. These Virginians are more often to be financially less able to weather economic downturns, and their capacity to meet their future mortgage, maintenance and utility obligations is compromised by the inherently higher costs for heating and cooling less-efficient dwellings. The structure's obsolete energy and conservation design accelerates the relative decline in value, potentially harmful for owners, tenants, their communities, as well as Virginia and our nation. As the electric and natural gas utilities enjoy the sovereign power of eminent domain, the higher utility costs enabled by the code's short-comings should be likened to a private tax imposed by for-profit businesses.

Such harm presents as structural racial bias in home ownership prospects. It is easily and cost effectively avoidable. Please consider how the Board may actively address this emerging injustice.

Sincerely,
Ross Shearer
Vienna, VA
CommentID: 83811

6/25/20 8:26 pm

Commenter: Ruth McElroy Amundsen

Please help make Virginia buildings more energy efficient

Virginia ranks very low out of the US States as far as energy efficiency. That hurts us in all kinds of ways. It means people are paying higher utility bills, in particular those that can't afford it. It means that we need more fossil fuels because we need more energy than the renewables we have. That means that we need fossil fuel infrastructure like compressor stations that tend to be sited in minority neighborhoods and thus adversely and dis-proportionately affect the health of minority residents. It also means that we are not succeeding in the fight against climate change, which means that low-lying areas like Hampton Roads are at more risk.

Buildings are a huge fraction of the state energy use. Please help Virginia cut that energy use and related carbon emission by updating the building codes to more efficient international standards that look toward the future.

This document has a collection of articles about how much renewable energy and energy efficiency can help us go carbon-free.

https://docs.google.com/document/d/1LjtamziqYH24JAZ4Y8RIDU0P7yr7UHP97FhxFfe_AZs/edit?usp=sharing

This site has information about the harm the pipelines do, and why we need energy efficiency to reduce our relaince on fracked gas pipelines.

http://va.mothersoutfront.org/pipelines

CommentID: 83812

6/25/20 11:40 pm

Commenter: Meredith Haines

Energy Efficiency improvements are low-hanging fruit

Let's pick that fruit already. Let's move Virginia from lagging to leading.

CommentID: 83813

6/26/20 12:14 am

Commenter: Chris LeMenestrel

Adopting the most recent building code is a WIN-WIN-WIN proposition

I recently replaced some old windows in my house, and I was very surprised that all the installers that came for a quote offered me untinted windows that do little to protect from the sun. I quickly found that most southern states recommend highly-tinted windows, which are much more efficient in the summer to keep the house cool.

After doing my research, I found that Virginia is one of the least energy-efficient state - where despite having some relatively low electricity rates, we have some of the HIGHEST electricity bills in the country due mostly to low energy efficiency standards.

I then found that Virginia building code on energy efficiency dates from the most part from 2015. There is an international building code as well as a US federal building code that are much more recent - ready to be adopted, they have done all the work - but Virginia has NOT adopted those latest, up-to-date codes.

This does not make sense. We are leaving on the table a win-win-win proposition: saving money in the long term, avoiding high electricity use and all of the issues related to that (air and water pollution, etc) - and worst of all - the opportunity to start addressing the climate crisis, that is with no doubt the most serious problem of our times.

CommentID: 83814

6/26/20 6:10 am

Commenter: C.D. Guillaudeu

Improving Virginia Energy Efficiency

Improving Virginia energy efficiency building code, both for Residential and Commercial buildings is a HIGH priority. Reducing carbon emissions, improving energy conservation, why is this even a question?

CommentID: 83815

6/26/20 6:29 am

Commenter: William Stewart, representing myself

Enhancing Building Energy Efficiency codes reduces owner costs AND carbon emissions

Our building energy efficiency codes are far behind most in the 1st world, and are one reason our building energy costs and carbon emissions are so high. Additionally, greatly improving our building energy efficiency building codes will make achieving our renewable energy targets far less expensive, so improving the code will be a win-win-win.

CommentID: 83816

6/26/20 9:08 am

Commenter: Sharon Shutler

Time for Virginia to Meet the 2018 International Energy Conservation Code

Virginia has not met the International Energy Conservation Code (IECC) since at least 2012. It is time to amend the Uniform Statewide Building Code (USBC) to meet the 2018 IECC energy conservation standards for all construction covered by the Virginia. Given that nationally, buildings represent 70% of electricity consumption, energy efficiency is one of the best and easiest ways to reduce electrical consumption and carbon emissions. In 2020, Virginia passed the Virginia Clean Economy Act - a landmark statue that calls for dramatic carbon reduction in light of the threat of climate change and the negative health, economic and environmental impacts it will bring across the Commonwealth. Bringing building codes up to energy efficiency standards laid out by the IECC will help us achieve those carbon reduction goals and create a clean energy economy. Furthermore, energy efficient buildings reduce utility bills of customers. Finally, Virginia law requires that the USBC protect the "health, safety and welfare of residents in the Commonwealth" and be be "consistent with recognized standards of health, safety, energy conservation and water conservation..." Minimizing costs to home builders must not take precedence over health and welfare of residences OR consistency with internationally recognized standards such as the IECC designed to do just that.

CommentID: 83817

6/26/20 9:10 am

Commenter: Nancy Najarian, VA Grassroots Coalition Clean Energy Working Group

Virginia Energy Efficiency Code for Residential and Commercial Buildings

I urge the Virginia Board of Housing and Community Development to amend the Uniform Statewide Building Code to meet or exceed the 2018 International Energy Conservation Code (IECC) for all forms of construction covered by Virginia's Uniform Statewide Building Code. Energy Efficiency (met by conservation, reduction in use/demand of energy with supporting building codes, etc.) is a low hanging fruit to pick for reducing energy demand and use, and a long lasting way to reduce green house gas emissions in the state. It also provides a healthier living and working environment for our residents, which turns into lower health costs, and much higher productivity for our employed citizens. I have worked on numerous energy efficiency projects with energy companies who increase the energy efficiency for institutions of higher education, municipalities, states, commercial entities and residences. There are a set of codes, and a path to providing energy efficiency be it in our utilities, in our government buildings and in our ways of life at work and at home. It is a win win situation for

all of us. We create jobs by increasing efficiency in new construction, and retrofitting older built environments. We employ energy efficient products (lighting, appliances, building materials and practices) all of which exist. There are no barriers to employing new energy conservation building codes than to simply adopt them. No one loses in this. Reducing the 60% (recently quoted by our VA legislators) consumption of energy that our built environments use in VA by energy efficiency measures supports the goals of the VCEA, and does not costs tax payers money that they won't recoup. There are clear pathways to do this achieved in other states. What is VA waiting for? Please make these important changes now. Thank you.

CommentID: 83818

6/26/20 9:16 am

Commenter: Amy Bergner

Time to update standards

The Board should update the Uniform Statewide Building Code to meet or exceed 2018 IEEC standards for all forms of covered construction. Virginia's recent adoption of VCEA demonstrates its commitment to allowing citizens to benefit from technology advances and lower utility bills resulting from energy efficiency. Now, the Board has the opportunity to align energy efficiency in building construction to help achieve VCEA's promise and directly impact consumer's individual control of their utility bills and carbon reduction. Virginia's continued economic prosperity depends on allowing consumers to benefit from advanced technologies and materials designed to meet updated IEEC standards.

-

CommentID: 83819

6/26/20 9:52 am

Commenter: Annette Lang, Virginia resident

Time for Virginia to meet the 2028 IECC

Time for Virginia to Meet the 2018 International Energy Conservation Code

Virginia has not met the International Energy Conservation Code (IECC) since at least 2012. It is time to amend the Uniform Statewide Building Code (USBC) to meet the 2018 IECC energy conservation standards for all construction covered by the Virginia Code. Given that nationally, buildings represent 70% of electricity consumption, energy efficiency is one of the best and easiest ways to reduce electrical consumption and carbon emissions. In 2020, Virginia passed the Virginia Clean Economy Act - a landmark statue that calls for dramatic carbon reduction in light of the threat of climate change and the negative health, economic and environmental impacts it will bring across the Commonwealth. Bringing building codes up to energy efficiency standards laid out by the IECC will help us achieve those carbon reduction goals and create a clean energy economy. Furthermore, energy efficient buildings reduce utility bills of customers. Finally, Virginia law requires that the USBC protect the "health, safety and welfare of residents in the Commonwealth" and be be "consistent with recognized standards of health, safety, energy conservation and water conservation..." Minimizing costs to home builders must not take precedence over health and welfare of residences OR consistency with internationally recognized standards such as the IECC designed to do just that.

CommentID: 83820

6/26/20 10:01 am

Commenter: David V. Sharp, Representing Self (Code Academy Instructor)

Notice of Violation Changes Weaken the Code Officials Ability to Properly Enforce Code

The changes to Section 115.2 to remove the “Responsible Party” are on dangerous legal ground.

First, one must recognize that according to Section 115.1, violation of the Building Code is a criminal offense (non-classed misdemeanor). “In accordance with § 36-106 of the Code of Virginia, it shall be unlawful for any owner or any other person, firm or corporation, on or after the effective date of any code provisions, to violate any such provisions.” Further, the Code intentionally employs language specifying that it is unlawful for “any person, firm or corporation to violate the code.” This purpose of this language to eliminate the possibility of a loophole for that would otherwise allow for work without a permit or work performed by contractors without a license where the code official would only have the option to charge the property owner with a criminal act.

Second, this change ignores the requirements set forth in 112.1 which states in relevant part: “It shall be the duty of *any* person performing work covered by this code to comply with all applicable provisions of this code and to perform and complete such work so as to secure the results intended by the USBC.” This language places a legal duty on the individual performing the work to comply with the Code and is intentionally worded in such a way that one cannot claim that they are not legally responsible simply because they are not the name listed on the permit. It is this section of the Code that defines for code officials who the "Responsible Party" is.

By removing the requirement to issue the Notice of Violation to the “Responsible Party” you get 2 very negative outcomes. First, this would result in issuing what amounts to a criminal citation to a homeowner simply because an unlicensed contractor duped them into obtaining the permit in their name. This is the legal equivalent of the police issuing a citation to the victim of a robbery simply because they failed to lock their door. Second, the real “criminal” (i.e. the unlicensed contractor) gets away with the criminal act because this change would redefine legal responsibility to the victim of the criminal act. Furthermore, simply allowing for the issuance of a Notice of Violation to other parties through permissive language while directing the issuance of of the notice to the permit holder ignores our responsibility as code enforcement officials to hold those performing the work accountable for proper, code compliant construction.

To illustrate the potential for serious legal implications, I will share an example from a locality that occurred when the NOV was incorrectly issued to a homeowner rather than the “Responsible Party.” The property owner was told by the “contractor” that if he obtained the permit, it would be cheaper and easier, as the County was more forgiving of homeowners than contractors. The unsuspecting owner obtained the permit in his name listing “Owner as Contractor” on the issued permit. The contractor was not properly licensed for the scope of work to be performed. There were numerous problems with the work that eventually led to the issuance of a NOV. The NOV was improperly issued to the homeowner, even though he was not the one performing the work and creating the violation condition. Meanwhile, the real violator was not cited and eventually simply walked off the job with money in hand and no legal ramifications. All that was bad enough, but it gets worse. The owner held a high-level security clearance with the Federal Government which was put at risk due to the improperly issued

citation. The unlicensed contractor, because no legal action was brought against him, was free to continue to victimize other unsuspecting property owners without consequence.

Finally, Code already recognizes that the ultimate purpose of the correction and Notice of Violation process is to achieve compliance with the Code – even when we are no longer able to pursue the "Responsible Party" to that end. That is why there is language differentiating to whom the NOV is to be issued, and who is to be copied. That is precisely why Section 115.2 contains the statement: "When the owner of the building or structure, or the permit holder for the construction in question, or the tenants of such building or structure, are not the responsible party to whom the notice of violation is issued, then a copy of the notice shall also be delivered to the such owner, permit holder or tenants." This portion of the process insures that the property owner/tenant (permit holder) is aware of the situation and provides a path forward to compliance should the real criminal (the Responsible Party) disappear.

It is critical to the proper enforcement of Code that we, as code officials, are diligent in pursuing the "Responsible Party." This change does not help to promote that end. In fact, it does quite the opposite, and weakens our enforcement position in the long run. I urge you to maintain the strong legal support for the issuance of citations to those who create the violation condition by rejecting this amendment.

CommentID: 83821

6/26/20 10:27 am

Commenter: Kathleen D Nawaz

Respect the intent and letter of the law on building energy efficiency

Virginia is currently ranked (by the American Council for an Energy Efficient Economy) as 29th, in the bottom half of US states. Energy efficiency should be the first energy source for buildings, which represent 40% of Virginia's energy use. Virginia has made strides to improve its standing, and Governor Northam recently made a commitment to energy efficiency and clean energy (in Executive Order 43, September 2019).

At the same time, Virginia law requires that the Board of Housing and Community Development to refer to the national standard on energy efficiency (the International Energy Efficiency Conservation Code, or IEECC) in setting standards. The Board should fully embracing the IEECC standards, or go beyond them. Although there are minimal increased upfront costs associated with higher energy efficiency, the payback period is short (often around 5 years) and the savings accrue each year afterwards, saving money and energy for decades to come, since buildings typically last 40-100 years.

Virginians already pay among the highest electricity bills in the country. Inefficient homes mean higher electricity bills. Higher bills hit lower income people and people of color hardest. At this time in our history, is that a statement that we, in the Commonwealth of Virginia, wish to make? I hope not.

I urge the Board to the IEECC standards for Virginia.

CommentID: 83822

6/26/20 10:39 am

Commenter: Delegate Rip Sullivan, House of Delegates

Choose Strong Energy Efficiency Standards

Dear Chairman Semones:

I write today in support of updating Virginia's residential building code with strong energy efficiency standards that reflect the urgent economic and environmental need to promote energy efficiency. I understand that the Board of Housing and Community Development (BHCD) is considering merely continuing current standards instead of modernizing them, and I encourage the Board to choose the latter option and help bring Virginia from the back to the front of the pack on energy efficiency.

As the House patron of the Virginia Clean Economy Act (VCEA), which created the Commonwealth's first energy efficiency resource standard for utilities, I collaborated with industry stakeholders, activists, constituents, and my fellow lawmakers on this important issue. Our work proved that there is clear bipartisan support in the General Assembly for ambitious energy efficiency standards and programs – it is the fastest, cheapest way to reduce energy bills and reduce carbon emissions. The VCEA made great strides on energy efficiency, but we have to do more if we are to maximize this important energy-saving tool in Virginia.

I urge the Board to adopt, at a minimum, the International Energy Conservation Code's (IECC) 2018 standards for all USBC-covered forms of construction. The Board should reject using the IECC's 2009 standards, which fail to reflect the technological advances of the last decade and do not meet the popular demand for strong energy efficiency requirements.

Thank you for your consideration, and I am ready to answer any questions that you may have.

Best,

Delegate Rip Sullivan

48th District of Virginia

CommentID: 83823

6/26/20 11:11 am

Commenter: Antonia Bouchard

Time for VA to meet International Energy Conservation Code

Time for Virginia to Meet the 2018 International Energy Conservation Code

Virginia has not met the International Energy Conservation Code (IECC) since at least 2012. It is time to amend the Uniform Statewide Building Code (USBC) to meet the 2018 IECC energy conservation standards for all construction covered by the Virginia Code. Given that nationally, buildings represent 70% of electricity consumption, energy efficiency is one of the best and easiest ways to reduce electrical consumption and carbon emissions. In 2020, Virginia passed the Virginia Clean Economy Act - a landmark statue that calls for dramatic carbon reduction in light of the threat of climate change and the negative health, economic and environmental impacts it will bring across the Commonwealth. Bringing building codes up to energy efficiency standards laid out by the IECC will help us achieve those carbon reduction goals and create a clean energy economy. Furthermore, energy efficient buildings reduce utility bills of customers. Finally, Virginia law requires that the USBC protect the "health, safety and welfare of residents in the Commonwealth" and be be "consistent with recognized standards of health, safety, energy conservation and water conservation..." Minimizing costs to home builders must not take precedence over health and welfare of residences OR consistency with internationally recognized standards such as the IECC designed to do just that.

CommentID: 83824

6/26/20 12:41 pm

Commenter: Samantha Ahdoot, Chair, Virginia Clinicians for Climate Action

Adopt IECC provisions to protect health and equity in Virginia

The Virginia Board of Housing and Community Development (BHCD) can ensure an energy-efficient, healthy future for the residents of the Commonwealth by updating the Virginia Uniform Statewide Building Code (USBC). Virginia Clinicians for Climate Action (VCCA) recommends that the BHCD meet or exceed guidelines in the most recent (2018) International Energy Conservation Code (IECC) to achieve this goal.

Numerous scientific studies have demonstrated that housing renovations based on various “green” building standards similar to those outlined in the IECC are associated with better human health (1, 2, 3, 4). Green building methods often involve improving ventilation, insulation, and heating and cooling equipment to increase energy efficiency and reduce pollutants; controlling moisture in buildings; and avoiding building materials that contain hazardous substances (1, 2). A study investigating the health effects of residential energy conservation among 248 households in Boston, Chicago, and New York City found that energy retrofits resulted in statistically significant improvements in general health and symptoms associated with sinusitis and hypertension (1). Green renovations of low-income housing in Washington, DC yielded significant improvements in general health, in addition to improvements in building dampness problems and reductions in cockroach and rodent allergens (3). Ventilation upgrades have been shown to relieve asthma-related and non-asthma respiratory problems (4).

Furthermore, energy-efficient homes can improve the well-being of Virginians through decreasing the financial burden associated with energy costs. Governor Northam’s Executive Order 43 recognized that low-income and minority households experienced higher energy-related financial burdens than the average household in the same city, and clean energy innovation can lower energy bills for these populations, promoting equity in Virginia (5). Low-income and minority populations disproportionately experience the harmful effects of climate change and environmental problems (6); adopting progressive building guidelines is a necessary step towards alleviating health disparities.

In the United States, buildings use 40% of our energy and 70% of our electricity, and emit over 33% of our greenhouse gas emissions (7). Energy production and emissions contribute to air pollution and climate change, both of which are associated with a multitude of direct and indirect health consequences. Continuously updating building codes will protect the future health of our community, as houses may last decades to over a century.

VCCA recommends that the BHCD adopt the latest IECC provisions and prepare to continue updating Virginia code in accordance with new IECC recommendations to best protect health and equity in the Commonwealth.

https://link.springer.com/article/10.1007/s12053-013-9216-8
https://journals.lww.com/jphmp/fulltext/2015/07000/Moving_Into_Green_Healthy_Housing.5.aspx
https://www.enterprisecommunity.org/download?fid=1560&nid=4271
https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3072905/
https://www.governor.virginia.gov/media/governorvirginiagov/executive-actions/EO-43-Expanding-Access-to-Clean-Energy-and-Growing-the-Clean-Energy-Jobs-of-the-Future.pdf
https://nca2018.globalchange.gov/
https://www.ase.org/initiatives/buildings

CommentID: 83825

6/26/20 1:09 pm

Commenter: Stair Z Calhoun, Network NoVA

Amend the Uniform Statewide Building Code

The Board of Housing and Community Development Amend the Uniform Statewide Building Code to:

- **Meet or exceed 2018 International Energy Conservation Code (IECC) for all forms of construction covered by Virginia's Uniform Statewide Building Code**
  - Note - Virginia has lagged behind conservation requirements of the IECC since at least 2012.
  - Energy Efficiency should be the cornerstone of building construction and rehab - this will significantly help to achieve dramatic carbon and energy reductions called for by the VCEA.
  - A customer's best defense against utility rates is to reduce energy usage and therefore utility bills. This is best done by maximizing the energy efficiency of buildings and appliances.
  - Nationally, buildings represent 70% of electricity consumption!

CommentID: 83826

6/26/20 1:32 pm

Commenter: Matt Wade

Require new petroleum retail stations to prepare for EV Charging

The Building Code should require all new petroleum retail facilities to prepare for electric vehicle charging stations by preparing electrical capacity for two level 2 stations (80 amp/240V per station) or one DC Fast Charging station (minimum 100 amp service per station).

CommentID: 83827

6/26/20 1:56 pm

Commenter: Shelley F Tamres

Upgrade the Uniform Statewide Building Code

It is critical to upgrade the Uniform Statewide Building Code to require high energy efficiency in all buildings, residential and business. This is an area that is ripe for transitioning off of fossil fuels cheaply. And we MUST transition off of fossil fuels asap. Remember, they're experiencing almost daily flooding in the Tidewater area. This is the right path for Virginia. Thank you for your time and attention.

CommentID: 83828

6/26/20 2:01 pm

Commenter: Jessie Clark

VA needs to be more energy efficient

It is time for Virginia to meet or exceed the 2018 International Energy Conservation Code (IECC) for all forms of construction covered by Virginia's Uniform Statewide Building Code. Virginia has lagged behind in conservation requirements and with our new VCEA, energy efficient buildings and any rehabs are going to be necessary. I did not realize it but nationally buildings represent 70% of electricity consumption! We need to start now in making our building codes more efficient.

Thank you,

Jessie Clark

CommentID: 83829

6/26/20 2:28 pm

Commenter: Garry Whelan, Personal

Improving the Energy Efficiency of New Homes

Science and practical development have brought about the potential for dramatic improvements in residential energy consumption. These improvements ensure a home will consume far less energy throughout the life of the home in order to provide a comfortable environment for the owners / occupants. This is good for the homeowner and good for the environment.

The costs to build in these improvements during construction are minimal. This is proven across other parts of the US and the world as a whole. The benefits are manifested throughout the life of the home, decades if not longer.

Virginian citizens deserve better homes that reflect the improvements possible in their construction. Regulations should be weighted so the buyer of the property gets a better built home rather than the builder who is currently providing homes far below what is possible. These changes bring minimal cost and effort but extensive gains for decades. Please improve the energy standards for new build homes.

CommentID: 83830

6/26/20 2:38 pm

Commenter: Susan L. Stillman Personal

Adopt the 2018 IECC building code as written

Virginians should be able to know that when they invest in a new home or have a home renovated that it is energy efficient. A home is an investment with monthly mortgage costs. When a home is not well built there is the additional burden of high heating and cooling bills. These bills, just like the mortgage must be paid every month for the life of the home. Building in efficiency up front is much less expensive than retrofitting later.

To mitigate high utility bills Virginia's building code should meet or exceed 2018 IECC energy conservation standards for all forms of construction covered by the USBC.

The BHCD should require builders to meet the full 2018 IECC standards for envelope efficiency – particularly walls and ceilings – not extend outdated 2009 standards that were superseded by the IECC in 2012.

The code should require builders to conduct a blower door test and to limit air infiltration to 3 air changes per hour, which has been the required since the 2012 IECC.

The home I grew up in was built in the 60's when there was a moratorium on new homes with natural gas. The home was very well built but it had resistance heat. My mother's electric bills were very high even though she only heated the room she was in. Virginia should require the installation of modern heat pumps and “mini-splits” and prohibit installation of electric resistance heating (e.g., electric furnace or baseboard heating).

Studies have shown that children raised in a home with natural gas cooking have a 48% higher rate of asthma. Homes should be set up to be ready to shift all electric. We have the technology now with heat pumps and induction cooking to make all electric homes safe, comfortable and affordable. Electric hot water heating with heat pump technology is very efficient.

Rehabilitated homes should have to meet the 2018 requirements as well. Renovating a home is expensive and homeowners should get the reduced energy bills affiliated with a well renovated home.

Homes of all types should solar ready and be wired for electric vehicle charging. I just had a 220 line run in my home. It was expensive to do in an existing dwelling and there are now many places where drywall has to be patched and painted. Installing an additional 240 line when a home is built is cost effective.

CommentID: 83831

6/26/20 2:59 pm

Commenter: Beth Kuhn

Strengthen building codes by adopting the latest IECC provisions

Please prioritize homeowners' needs by adopting standards that require energy conservation and efficiency, and that require new buildings to be sited and wired for solar and electric vehicle technology. This will bring homeowner costs down over the long run. As Virginia transitions to clean energy and energy efficiency, housing is a critical part of the equation, accounting for 40% of energy use in Virginia. Virginia's building codes need to reflect technological advances in energy conservation, and need to be in step with the critical need to reach zero net carbon emissions.

CommentID: 83832

6/26/20 3:00 pm

Commenter: Elizabeth Ende

Update Virginia's Building Code to reflect strong energy efficient standards

I am writing to ask that you update Virginia's residential building code with strong energy efficiency standards, not just to maintain the status quo. Now is the time to modernize the standards that were developed ten years ago, before many technological advances had been made or envisioned. An update to the building code will materially reduce energy use and the size of our carbon footprint. It is your job to keep the best interests of Virginia residents in your focus as you make this important change to the Virginia Building Code. Thank you in advance for looking out for Virginia residents, their children and their grandchildren and the future of our planet!

CommentID: 83833

6/26/20 3:07 pm

Commenter: Judy Gayer

Please keep in mind that the ARCTIC posted a record high 100.4 degree temperature last week!

We can no longer afford to treat our activities that affect the environment as "business as usual." All industries, including the building industry, must adjust to minimize their impact on further degradation of the environment. Updating our outdated building codes is key to recognizing the reality we all face. Yes, this increases upfront costs a bit, but the long term reduction in cost - both to homeowners and to the environment - far outweigh those costs.

CommentID: 83834

6/26/20 3:42 pm

Commenter: Melinda Reingold

Home cannot be imperiled by homes.

We are in an existential moment and we need to do everything we can to be certain that this planet remains habitable. The earth is our most basic Home. Construction of human-built homes should be done in a way that ensures they are safe and environmentally sound. I don’t think permitting builders to save money is a good counter-argument to this imperative.

CommentID: 83835

6/26/20 3:52 pm

Commenter: Melanie Barton

Virginia Energy Efficiency

Please improve the energy efficiency codes for residential and commercial buildings in Virginia. The time is now or yesterday for making these changes. People who negligently waste energy today are robbing the future from our children and the next generation, if not this one with all the sickness. Please do this.

CommentID: 83836

6/26/20 6:28 pm

Commenter: Sarah Richardson, personal comment

Virginia residents need energy efficient buildings

The best way to save energy is not to spend it in the first place! Energy efficiency for buildings allows every Virginian to participate in a solution to cutting carbon emissions while also saving on heating bills. The transition to a sustainable energy economy has to happen in a lot of areas, and energy efficiency in buildings is a common-sense place to start. Time for Virginia to get on board with improved standards.

CommentID: 83837

6/26/20 8:00 pm

Commenter: Walton C. Shepherd

Please adopt 2018 IECC with no weakening building envelope amendments

Dear Board Members and Staff,

On behalf of the NRDC (Natural Resources Defense Council) and our over 9,500 paying members in Virginia, we submit the following comments on the proposal to update the energy provisions of Virginia's Uniform Statewide Building Code (USBC).

This update is an important and long-lasting opportunity for the Board to protect the economic well-being of Virginians for generations to come. Just as impactful, buildings are responsible for about 40 percent of all carbon emissions in the US, and the buildings constructed today will be in use for 50 to 100 years, or more. In addition to long-lasting climate benefits, constructing efficient buildings from the start will yield energy and cost savings over the entire lifetime of the building, while ensuring greater levels of comfort and safety for inhabitants.

Virginia has recognized the need to act to avoid the most costly impacts of climate change, recently passing the Virginia Clean Economy Act and joining the Regional Greenhouse Gas Initiative to reduce carbon pollution from the power sector. A strong, robust, continually-improving building energy code is a crucial policy tool that is fully consistent with the Commonwealth's carbon reduction goals. In fact, it will be impossible to achieve meaningful climate goals *without* addressing the energy consumption of buildings. Improving building energy efficiency is one of the best and most cost-effective tools we have to reduce the effects of climate change, while keeping people more comfortable and lowering energy bills.

NRDC fully supports Virginia's efforts to update the energy provisions of the USBC. We encourage clean adoption of the 2018 International Energy Conservation Code (IECC), with strengthening amendments as described below.

Adopt the 2018 IECC

We urge Virginia to adopt, at a minimum, the 2018 IECC without any amendments that would weaken the efficiency of the code. Currently Virginia follows the 2015 IECC, but with weakening amendments. Given the scope and magnitude of the climate crisis, it is important for new buildings to be built as efficiently as possible, and as soon as possible. A number of other states, including neighboring Maryland, have adopted energy codes that are at least as efficient as the 2018 IECC, and with no weakening amendments.

Compared to the current USBC, the 2018 IECC includes more stringent requirements for building envelope improvements, including better wall insulation, ceiling insulation, and air infiltration requirements. These measures will cost about $600 more to install at the time of construction.

However, according to analysis by the Responsible Energy Codes Alliance, improved insulation requirements will save upwards of $100 *each year* – savings that continue through every year of the life of the building.

People who purchase new construction homes tend to have higher incomes, with nearly half reporting a household income of more than $100,000. However, long-term savings measures installed at the time of construction are important for lower income residents, as well. The second, third, or fourth owners or occupants of any given home may be households with lower incomes. The benefits of measures like insulation will last for the lifetime of the home, and will benefit subsequent homeowners or renters.

Likewise, improved efficiency is especially important in multifamily buildings, which tend to be rented rather than owned. Renters have very little control over the building envelope and equipment, and can suffer the consequence of high energy bills with no way to improve the building. Constructing efficiently from the start will mean lower bills and better health and comfort for years to come.

Additional Improvements Mean More Benefits

Adopting the 2018 IECC without weakening amendments should be the absolute minimum.

There are a number of additional strengthening proposals that should be considered and adopted.

Require electric readiness

A key component of the fight against costly climate change is reducing the use of fossil fuels, including fossil fuels used on site in a building for water heating, space heating, clothes drying, and cooking. Preparing a building for future electrification of some of these end uses is straightforward and inexpensive at the time of construction: it simply requires the appropriate electrical outlet and spacing for future electric appliances. Doing so protects homeowners from future costs, should natural gas become less affordable or even unavailable over the life of the building. In addition, there are substantial indoor air quality benefits from choosing electric equipment over fossil fuel combustion equipment, which could be very important for people with certain health conditions.

As the electric grid becomes cleaner, and high-efficiency electric heat pump technology increasingly offers utility bill and pollution reduction benefits over gas, more customers may want to transition from natural gas to electric space and water heating. Federal, state, and local environmental and public health policies may also encourage, or even require the transition in some areas. Electric-ready requirements will protect customers from high retrofit costs. Proposal RE147-19 was recently adopted into the 2021 IECC, and language in that proposal should be considered for adoption in Virginia.

Require electric vehicle readiness

Similar to making a building ready for future electrification of end uses, homes, multifamily buildings, and commercial buildings should be required to meet electric vehicle (EV) readiness requirements. This does not mean installing a full EV charging system, but simply ensuring that the proper wiring, circuitry, and electrical panel space is available for the installation of a future EV charger. The cost savings of installing EV capability at the time of construction is immense: a 2018 study by the California Air Resources Board found a cost savings of up to $8,000 by installing EV charging infrastructure in commercial/multifamily buildings, as compared to the cost of retrofitting. Proposals CE217-19 Part 1

and CE217-19 Part 2 were both adopted as part of the 2021 IECC, and should be considered as an appropriate model for electric vehicle readiness.

Continual Improvement

Virginia's building code has lagged behind the model IECC codes for far too long. Given the magnitude of the power plant carbon reductions required under the Virginia Clean Economy Act, Virginia must prioritize the energy efficiency of its new construction. Adopting a clean 2018 code is a start, but progress must continue. We request that the Board of Housing and Community Development adopt a policy committing Virginia to adopt the most recent IECC, without weakening amendments, each time it is updated. Failure to do so will mean higher bills for residents and businesses, more wasted energy, and more climate pollution for decades to come.

Better building codes are a common-sense way to address costly climate change while saving money and energy in the immediate term.

Updating to the 2018 IECC, without weakening amendments, is a great start – but it doesn't go far enough. Committing to more energy efficiency both now and in the future will mean a healthier, cleaner Virginia for all.

Thank you,
Walton C. Shepherd
Virginia Policy Director & Senior Attorney, NRDC
2105 M Street, Richmond, VA 23223
CommentID: 83838

6/26/20 8:12 pm

Commenter: Natalie Pien, 350 Loudoun

Virginia's Energy Efficiency ranking is appalling and unacceptable

Virginia's ACEEE energy efficiency ranking 35th out of 48 is unacceptable. The Commonwealth has an advanced economy and a literate, politically savvy population. There is no reason to accept such a low ranking, which DROPPED recently. Buildings account for 40% of energy use. Old, outdated, inadequate building codes must be replaced by modern standards that reflect advances in technology. Using better materials and better practices, while more expensive to use, more than pays for itself in the cost savings enjoyed for years to come. Virginians don't need to pay for electricity bills that are artificially higher due to bad building codes. Virginia must address climate change by decreasing it's greenhouse gas emissions, and that includes improving building codes to ensure weather-tight, well insulated structures. Instead of catering to the building industry, regulators must act on the best interests of Virginians and on protecting Virginia's environment. Responsibly addressing the Climate Crisis requires strong, up-to-date building standards. Raise Virginia's energy efficiency ranking by adopting strong, modern building codes.

CommentID: 83839

6/26/20 8:13 pm

Commenter: Natalie Pien, Personal comment

Virginia's Energy Efficiency ranking is appalling and unacceptable

Virginia's ACEEE energy efficiency ranking 35th out of 48 is unacceptable. The Commonwealth has an advanced economy and a literate, politically savvy population. There is no reason to accept such a low ranking, which DROPPED recently. Buildings account for 40% of energy use. Old, outdated, inadequate

building codes must be replaced by modern standards that reflect advances in technology. Using better materials and better practices, while more expensive to use, more than pays for itself in the cost savings enjoyed for years to come. Virginians don't need to pay for electricity bills that are artificially higher due to bad building codes. Virginia must address climate change by decreasing it's greenhouse gas emissions, and that includes improving building codes to ensure weather-tight, well insulated structures. Instead of catering to the building industry, regulators must act on the best interests of Virginians and on protecting Virginia's environment. Responsibly addressing the Climate Crisis requires strong, up-to-date building standards. Raise Virginia's energy efficiency ranking by adopting strong, modern building codes.

CommentID: 83840

6/26/20 9:16 pm

Commenter: Network NoVA, WofA We of Action

Amend VA building code to meet/exceed 2018 IECC energy efficiency code for all construction

The VA Board of Housing and Community Development should amend the Uniform Statewide Building Code to meet or exceed 2018 International Energy Conservation Code (IECC) for all forms of construction covered by Virginia's Uniform Statewide Building Code.

-
  - Virginia has lagged behind conservation requirements of the IECC since at least 2012.
  - Energy efficiency is the most low-cost energy source, and should be the cornerstone of building construction and rehabilitation, and is key for making progress towards targets to reduce energy consumption and carbon emissions under the VCEA - VA Clean Energy Act.
  - Investment in energy efficiency of buildings and appliances will yield benefits to consumers in lower energy usage and utility bills.
  - Nationally buildings represent 70% of electricity consumption!

CommentID: 83841

6/26/20 9:34 pm

Commenter: Smita Chandra Thomas, Energy Shrink, LLC

Virginians are ready for a change, a comfortable change

1. Virginians deserve thermally comfortable buildings

Better insulated buildings with more efficient systems are more comfortable to live and breathe in -- they don't get too hot or too cold regardless of the weather.

Updated codes will help ensure that Virginia is keeping pace with the improved understanding of what it takes to make the buildings best suited for the climate. Let's give Virginians the best.

2. Recent election results have shown that Virginians are ready to embrace progress

While most residents are not aware of codes, they are quite aware of new announcements being made by their new representatives. They are hungry to hear that we are moving in the right direction, and bringing in meaningful change. Codes are the most effective way to reduce energy use and emissions from buildings (ACEEE) -- buildings are the largest sector where meaningful reductions in emissions can be made to slow down climate change (Mckinsey, IEA). Climate change is a big issue on the mind of constituents, red or blue. Let's put them at ease with impactful updates. (Imagine the headlines!)

3. Costs are a non-issue compared to increased disposable income

The stakeholder process used in code development ensures that only the most cost-effective standard measures make it to the codes. Besides, the price of upgrades to the latest code are minor compared to other real estate pricing concerns, especially in the urban markets. So, financial concerns should not hold us back. The savings from utilities will most likely be pumped back into the Virginia economy (more Virginia wine, anyone?). Let's provide Virginians with more disposable income.

Bottomline: Let's adopt the current IECC codes (2018) (and leave our neighbors in the dust.)

CommentID: 83842

6/26/20 9:40 pm

Commenter: Freeda Cathcart

Virginia energy efficiency building code

The Board of Housing and Community Development Amend the Uniform Statewide Building Code to:

- **Meet or exceed 2018 International Energy Conservation Code (IECC) for all forms of construction covered by Virginia's Uniform Statewide Building Code**
  - Note - Virginia has lagged behind conservation requirements of the IECC since at least 2012.
  - Energy Efficiency should be the cornerstone of building construction and rehab - this will significantly help to achieve dramatic carbon and energy reductions called for by the VCEA.
  - A customer's best defense against utility rates is to reduce energy usage and therefore utility bills. This is best done by maximizing the energy efficiency of buildings and appliances.
  - Nationally, buildings represent 70% of electricity consumption!

CommentID: 83843

6/26/20 10:06 pm

Commenter: Beth Hodsdon

Building Code revision

I am writing to request that any revisions to the residential building code strengthen--not loosen--requirements for energy efficient siting, materials and construction, so that housing helps Virginia meet its goals for conserving energy and mitigating climate change. Home buyers will benefit since energy-efficient housing will reduce operating costs and so save them money. Thank you for this opportunity to comment.

CommentID: 83844

6/26/20 11:01 pm

Commenter: Keith Oberg, Langley Hill Friends Meeting

Time for Virginia to Meet the 2018 International Energy Conservation Code

Virginia has not met the International Energy Conservation Code (IECC) for at least the last eight years. It is time to change this and amend the Uniform Statewide Building Code (USBC) to meet the 2018 IECC energy conservation standards for **all** construction covered by the Virginia Code. Given that nationally, buildings represent 70% of electricity consumption, and electricity prices in Virginia are among the country's highest, investments in energy efficiency provide immediate and cost-effective economic and financial returns, and are one of the best and easiest ways to reduce electrical consumption and carbon emissions. Energy-efficient buildings reduce utility bills of customers and provide these benefits over the long term. In 2020, Virginia

passed the Virginia Clean Economy Act - a landmark statue that calls for dramatic carbon reduction in light of the threat of climate change and the negative health, economic and environmental impacts (e.g., sea-level rise in Tidewater, more energy-intensive storms) it is already bringing across the Commonwealth. Bringing building codes up to energy efficiency standards laid out by the IECC will help us achieve those carbon reduction goals and create a clean, stable, and more equitable energy economy. Finally, Virginia law requires that the USBC protect the "health, safety and welfare of residents in the Commonwealth" and be "consistent with recognized standards of health, safety, energy conservation and water conservation..." Minimizing up-front costs to home builders must not take precedence over health and welfare of residents, protection of the environment and reduction of carbon pollution, OR consistency with internationally recognized standards such as the IECC, which are designed to promote citizen health and welfare.
CommentID: 83845

6/26/20 11:06 pm

Commenter: Blythe Merritt

Improve Virginia's energy efficiency codes

Improve Virginia's energy efficiency codes to save residents money and reduce our impact on the climate; please amend the Uniform Statewide Building Code (USBC) to meet the 2018 International Energy Conservation Code for all construction covered by the Virginia.