Embracing Challenges for Power Engineering Sustainability

Keynote Speech

Saifur Rahman, PhD
President, IEEE Power & Energy Society 2018-2019
PES APPEEC Conference, Kota Kinabalu, Malaysia, 08 October 2018

Virginia Tech Research Center
Arlington, Virginia, USA
IEEE at a Glance

- 423,000+ Members
- 190+ Countries
- 46 Technical Societies & Councils
- 117,000+ Student Members
PES is the Second Largest Society in the IEEE

IEEE
423,000+ members
160 countries
Founded 1963

IEEE PES
38,900+ members
Current President
Saifur Rahman
Virginia Tech University

38
Other
IEEE Societies

250+
Chapters
Across 10
Global Regions

New Initiatives
& Outreach

Membership &
Image

Publications

Education

Technical
Activities

Meetings

PES Governing Board includes
Vice Presidents which oversee

Technical
Committees

Standing
Committees

Standards Developing
Technical Committees

Coordinating
Committees

Global Engagement through Local Chapters

Region 1-7
128 chapters
(20,424 members)

Region 8
48 chapters
(5,969 members)

Region 9
36 chapters
(3,590 members)

Region 10
46 chapters
(8,941 members)

Over 38,900
members from
150 countries

258 Chapters and 358 Student Chapters: PES Chapters are a great way to plug in to the society in most parts of the world and get involved.
Boost employees engagement by providing your professionals with:

• Latest information about current trends and all aspects of the fast-changing industry
• Industry insight through Power & Energy and Electrification magazines, technical reports and peer-reviewed journals
• Compelling programs and peer engagement at our conferences and events
• Platforms to tackle challenges via IEEE standards-development and technical committees
• Opportunities to meet and collaborate via our local chapters and the global PES community

Get involved. Email: pes@ieee.org

Memoranda of Understanding with:
• U.S. Department of Energy
• U.S. Federal Energy Regulatory Commission (FERC)
• Ecuador Ministry of Energy
• State Grid Corporation of China
• Northeast Electric Power University, China

Expanded Cooperation with:
• North American Electric Reliability Corporation (NERC)
• European Commission
• California Public Utility Commission
• Other global agencies

MOU Signing at China State Grid

At China State Grid Headquarters, Beijing, 27 Nov 2017
Jilin City, China, 30 November 2017

Global Conferences

Dallas
Portland
Sarajevo
Genk
Kota Kinabalu
Sarajevo
Cape Town
Singapore

PES organizes over 30 conferences per year in more than 20 countries
Engaging with Peers Since 1884

- Publishing Research
- Sharing Ideas with peers
- Posters Presentations
- Standards Development

The IEEE PES Resource Center

Access over 1,400 items – the most extensive library of content in the world devoted exclusively to the field of power and energy.

Everything you need in one place!

- Tutorials
- Videos
- Technical Reports
- Journal Articles
- Archived Webinars
- Conference Slides
- And More!

Learn more. Visit: resourcecenter.ieee-pes.org
Developing Women in Power

Fostering a more diverse leadership by supporting the career advancement, networking and education of women in the energy industry.

Get involved. Visit: pes-women-in-power.org

Mentoring Young Professionals

Helping young professionals evaluate their career goals, polish their professional image, and create the building blocks of a lifelong and diverse professional network.

Over 3,200 PES Young Professionals worldwide, and growing!

Get involved. Visit: sites.ieee.org/pes-yp
PES Scholarship Plus

• Addressing the power and energy workforce shortage in USA, Canada, Puerto Rico, India & Italy
• Goal: distribute as many scholarships as possible to attract top EE students into power & energy careers

Solid impact to date. But additional support (both financial & internships) is needed

Get involved. Donate Online. Visit: ee-scholarship.org

IEEE SMARTGRID

Collaborating to encourage the successful rollout of technologically advanced, environment-friendly and secure smart-grid networks around the world.

• Set the Global Standard via Collaboration
• Provide Education, Research and Innovation
• Expand Global Reach via Marketing

Get involved. Visit: smartgrid.ieee.org
Brings together various IEEE’s technical societies and organizations to advance the state of the art for smart city technologies for the benefit of society.

Serves as neutral broker of information amongst industry, academic, and government stakeholders.

- Smart Buildings
- Smart Living
- Smart Transportation
- Smart Energy
- Smart Communications
- Smart Networks
- Self-Aware Digital Hub
- Environmental Awareness

Achieving global impact, IEEE Smart Village is dramatically bettering the lives of more than 100,000 off-grid villagers with light and modest power. An institute-wide humanitarian program supported by PES and a signature program of the IEEE Foundation.

Get involved. Visit: ieee-smart-village.org
Stay Technically Proficient with PES

PES is deploying significant resources for training and lifelong learning activities for our practicing engineer members. Many resources are eligible for CEUs PDHs!

Embracing Challenge to Remain Relevant
Traditional Electric Power Engineering

For the 19\textsuperscript{th} and the 20\textsuperscript{th} centuries electric power engineering has meant power stations, transmission and distribution networks, high voltage engineering, electric machines, switchgear, transformers and automatic generation control on the hardware side and stability, transient, load flow and production costing studies on the software side.

New Paradigms in Electric Power Engineering

- Electric Vehicles
- Renewable Energy
- Storage Applications
- Smart Grids
- Smart Cities
- Demand Response
- Renewables Integration

Heavy usage of communication technologies
Electrification Was The Most Important Innovation of The 20th Century
Birth Of A New Industry

Thomas Alva Edison at Menlo Park, New Jersey [1876]

This laboratory set-up laid the foundation for several inventions to come, including phonograph and the electric bulb.

Source: RUTGERS School of Arts and Sciences, http://edison.rutgers.edu/inventionfactory.htm, April 2017

Electric Street Lights

Street Lights: First electric lighting, New York, USA [1882]

First demonstration of DC street lighting system

**Lighting up the Brooklyn Bridge, New York**

Edward Weston, President of AIEE [1888-89]

Illumination of Brooklyn Bridge [1899]


©2017 Saifur Rahman

---

**The White City, Chicago**

With a press of a button 1000 lights lit up [1893]
Witnessing over 90,000 lights for the first time...


©2017 Saifur Rahman
Electric Street Cars in New York City

Streetcars traveling on Broadway at Union Square in 1904 were propelled by electricity from the slot in the road.

Source: “The slot in the road: Manhattan’s forgotten underground electric trolley system,” Gilmore.

The First Telephone Call

Made on 10th March, 1876– Alexander Graham Bell in his Boston Laboratory calling Watson
A Telephone Switching Station

A large Bell System international switchboard in [1943]


Wireless Telegraphy

Guglielmo Marconi, inventor of wireless telegraphy in 1896

Today’s Wireless Phones

Telecom Tower

Evolution of the Telephone

Normal Phone  Smart Phone

©2017 Saifur Rahman
Electric Power Grid: Past & Present

Source: http://www.jsteelstructure.com

Source: www.sxc.hu

SCADA System

SCADA system for monitoring


©2017 Saifur Rahman
Energy Management System (EMS)

Energy Management Systems


©2017 Saifur Rahman

Computers and Controls

Computer Controls and Software


©2017 Saifur Rahman
Evolution of the Sources of Electricity

Solar Power Plant

Wind Farm

Wind Farm 1

©2017 Saifur Rahman

Large Scale Hydroelectricity

Hydro Power plant – Three Gorges Dam, China.
The Use of Other Technologies In Electric Power Systems

Power Electronics

Sensors


Electric Power Industry is the Playground

Build (almost) anything you want

In a safe environment, with clear boundaries and safeguards

We may relax some (but not all) of our rules

Consequences of failure can be contained

Technologies Come Together in the Smart Grid

Smart Grid Technologies


Electric Power Engineering Past, Present and Future

- Electric power is the foundation of electrical engineering
- Electric power industry has encompassed other areas of electrical engineering to provide a robust power supply network
- Renewable energy, smart grid, smart cities, new applications of electrification, etc. will define the future of this industry
Thank You!

Saifur Rahman, PhD
President, IEEE Power & Energy Society 2018-2019
s.rahman@ieee.org
www.saifurrahman.org