American International University-Bangladesh (AIUB)

SDG Activity Report on

SDG 7:
Affordable and Clean Energy

SDG Activity Report on

SDG 7: Affordable and Clean Energy

Contents

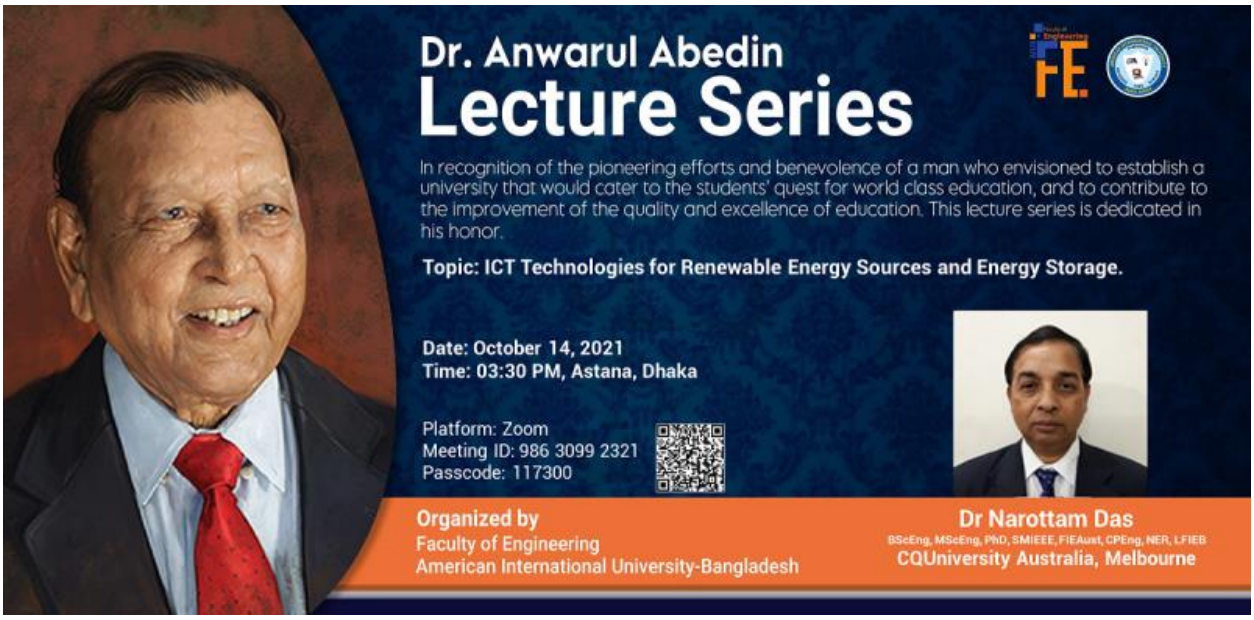
University Activities

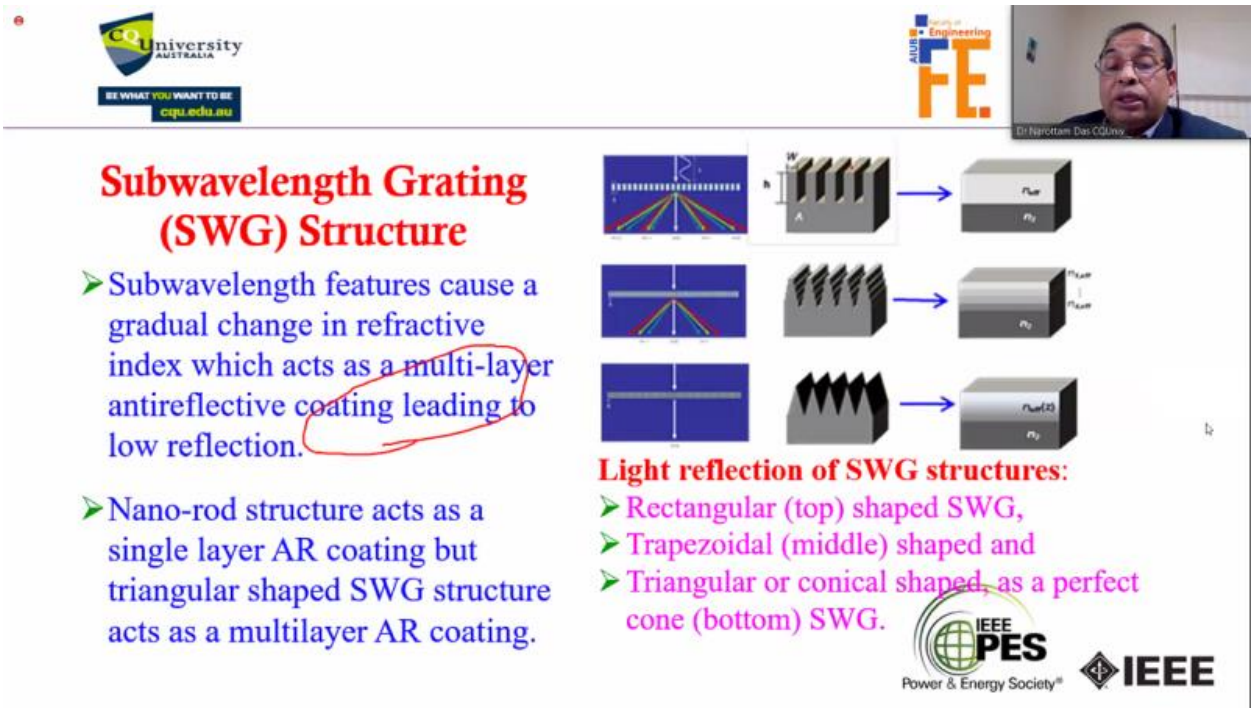
Dr. Anwarul Abedin Lecture Series “ICT Technologies for Renewable Energy Sources and Energy Storage”

As a part of the "Dr. Anwarul Abedin Lecture Series", a regular development initiative of the American International University-Bangladesh (AIUB), a research talk titled "ICT Technologies for Renewable Energy Sources and Energy Storage" was held through online platform Zoom from 04:00 PM- 06:00 PM (BDT) on October 14, 2021, Thursday. The Electrical and Electronics Engineering (EEE) department organized this event and invited prominent researcher Dr. Narottam Das (BScEng, MScEng, PhD, SMIEEE, FIEAust, CPEng, NER, LFIEB), CQ University Australia, Melbourne, as the speaker.

The webinar was inaugurated with a welcome address by Dr. ABM Siddique Hossain (Professor and Dean, Faculty of Engineering). He started by paying gratitude to Dr. Anwarul Abedin, AIUB's Founder-Chairman, who contributed significantly to the university's development. He then discussed how applications of ICT in the smart grid are creating greater shifts differentiating from traditional power grid, leading to ample opportunities for future employment sector globally. Then the esteemed speaker for the event, Dr. Das, started his talk by explaining his three recent research works based on ICT applications for renewable energy sources and energy storage. The first research demonstrated and confirmed pillar-shaped nano-grating structure to be an excellent anti-reflective coating for highly efficient GaAs solar cells. The second research work involved technical and economic performance analysis of six different cases of grid system based on demand of real residential data of a regional location of Victoria, Melbourne, Australia which concluded two cases to optimize lower levelized cost of electricity and a good energy supply to grid as well. Lastly, the third research based on a hybrid system (solar/wind/diesel) proved to be most cost-effective compared to other combinations of hybrid systems in relation to net present cost / cost of energy.

Once the talk ended, Md. Ashif Islam Oni (Assistant Professor, Department of EEE), the moderator, announced the start of a question-answer session where the speaker enthusiastically responded to the queries raised by the faculty members in the audience. The participants also discussed further collaborative research ideas for future implementation in Bangladesh. Dr. Mohammad Abdul Mannan (Professor and Director, Faculty of Engineering) provided the closing remarks by thanking Dr. Das for the enlightening session and offering a digital Certificate of Appreciation as a token of gratitude for sharing his valuable time and insight. The event was graced by the presence of Dr. Md. Abdur Rahman (Professor and Associate Dean, Faculty of Engineering), Mr. Nafiz Ahmed Chisty (Associate Professor and Head In-Charge, Dept. of EEE), Mr. Md. Saniat Rahman Zishan (Associate Professor and Head, Dept. of CoE) along with other faculty members and students from the Faculty of Engineering.


Dr. Anwarul Abedin
Lecture Series
In recognition of the pioneering efforts and benevolence of a man who envisioned to establish a university that would cater to the students' quest for world class education, and to contribute to the improvement of the quality and excellence of education. This lecture series is dedicated in his honor.
Topic: ICT Technologies for Renewable Energy Sources and Energy Storage.
Date: October 14, 2021
Time: 03:30 PM, Astana, Dhaka
Platform: Zoom
Meeting ID: 986 3099 2321
Passcode: 117300
Organized by
Faculty of Engineering
American International University-Bangladesh
Dr Narottam Das
BScEng, MScEng, PhD, SMIEEE, FIEAust, CPEng, NER, LFIEB
CQUniversity Australia, Melbourne


Subwavelength Grating (SWG) Structure
Subwavelength features cause a gradual change in refractive index which acts as a multi-layer antireflective coating leading to low reflection.
Nano-rod structure acts as a single layer AR coating but triangular shaped SWG structure acts as a multilayer AR coating.
Light reflection of SWG structures:
Rectangular (top) shaped SWG,
Trapezoidal (middle) shaped and
Triangular or conical shaped, as a perfect cone (bottom) SWG.
IEEE PES Power & Energy Society
IEEE

SAB AIUB Unit Face Successfully Organized a Two-Days Workshops on “Professional Solar PV Design “

Solar photovoltaic (PV) panels undoubtedly come to peoples' minds when they talk about solar energy. The use of solar PV panels in our country is increasing day by day. At the same time, the demand for solar PV design is rising. Many engineers in our country work with solar PV design, and "ESAB AIUB unit face" organized a "Professional Solar PV Design" workshop for future engineers on the 7th and 8th of October,2021, and completed the workshop in its entirety.

Main program began with the national anthem, which was accompanied by displaying country's national flag. Subsequently, additional specifics about the work of ESAB AIUB UF and a short film of what ESAB has accomplished thus far were presented. Mr. Sheikh Rafat Bin Ali (Founder, Ulterior Engineering & Research Institute) served as the instructor for "Professional Solar PV Design" program. He was enthusiastic and supportive throughout the program. During the session's opening remarks, Dean of Faculty of Engineering, AIUB Prof. Dr. ABM Siddique Hossain, welcomed the speaker as well as the audience. Approximately 35 students participated in this workshop. On the first day of the program, there was a basic introduction to solar PV design, and following the basic introduction, several intermediate and high-level concepts were discussed. In the fundamental lecture, the ideas of solar sale, solar panel, solar string, and solar array were discussed. The workshop also provides students with an understanding of investment feasibility analysis, growth recommendations, investment return analysis, trends analysis, opportunity analysis, and SWOT analyses of competing organizations, among other features that will significantly benefit them in their future careers. On the second day, there were talks about the designing component and practical exercises. During this section, a thorough tour of the PVsyst software was provided. Solar photovoltaic systems were also investigated from the standpoints of physics, mathematics, and aesthetics. Moreover, an outline of a significant study conducted to build a PVsyst design for a client was provided.

At the end of workshop, there was a question-and-answer session where the workshop instructor addressed the questions raised by the participants. At the conclusion of the workshop, instructor of this workshop was presented with an official certificate by the ESAB AIUB unit face.

A WEBINAR TITLED "ELECTRICAL SUBSTATION TESTING COMMISSIONING AND MAINTENANCE"

On August 5, 2021 (Thursday), Faculty of Engineering organized a webinar titled "Electrical Substation Testing Commissioning and Maintenance" which was supported by AIUB Community of Engineering Students (ACES). The program began at 07:30 PM with over 240 participants attending via the online platform Zoom. The purpose of this webinar was to provide idea about commissioning & testing an electrical substation and the procedure followed by the maintenance team. Prof. Dr. A.B.M. Siddique Hossain (*Dean, Faculty of Engineering, AIUB; Advisor, ACES*) inaugurated the webinar by encouraging the students to be more skilled in commissioning, testing and maintenance of power grid system to ensure the public safety, health, and welfare.

Afterwards, Mr. Abu Bakar Shiddik (*Deputy Managing Director, Reverie Power & Automation Engineering Ltd*.), began his speech by expressing gratitude towards all the faculty members of AIUB and the participants for their enthusiasm and interest in power grid system. Thereafter, he introduced himself and continued his speech by sharing his professional knowledge and experience. He further went on describing the power generation, transmission and distribution tropology. Different types of transformers were also demonstrated. Moreover, he elucidated several types of transformer pre-commissioning and yearly maintenance testing. After that Q&A session was held where the speaker answered to the queries of the participants. Following that, Prof. Dr. Md. Abdur Rahman (*Associate Dean, Faculty of Engineering, AIUB; Advisor, ACES*) emphasized the importance of power system prevention, since it is extremely difficult to recover from a power system hazard. Finally, the webinar was concluded at 10:00 pm by thanking everyone for their participation and taking a group snapshot with the presence of Prof. Dr. A.B.M. Siddique Hossain (*Dean, Faculty of Engineering, AIUB; Advisor, ACES*), Dr. Md. Abdur Rahman (*Professor, Associate Dean, Faculty of Engineering, AIUB; Advisor, ACES*) , Dr. Md. Abdul Mannan *(Professor and Director, Faculty of Engineering, AIUB*), Mr. Nafiz Ahmed Chisty *(Associate Professor and Head In-Charge, Dept. of EEE, AIUB),* Mr. Chowdhury Akram Hossain *(Senior Assistant Professor and Special Assistant of OSA, Faculty of Engineering, AIUB),* Mr. Md. Saniat Rahman Zishan (Head, Dept. of CoE & Senior Associate Professor, *Faculty of Engineering, Mentor, ACES),* Mr. Abir Ahmed (*Lecturer, Dept. of CoE, AIUB; Motivator, ACES*) , Mr. Asif Mahfuz (*Lecturer, Faculty of Engineering, AIUB*), Dr. Md. Ehsanul Haque (*Assistant Professor, Faculty of Engineering, AIUB*), Mr. Farhadur Arifin (*Associate Professor, Faculty of Engineering, AIUB*) , Dr. Md. Rifat Hazari (*Assistant Professor , Faculty of Engineering, AIUB*), Mr. Kawshik Shikder (*Assistant Professor*, *Faculty of Engineering, AIUB*), Mr. Md. Khurshed Alam (*Assistant Professor*, *Faculty of Engineering, AIUB*), Mr. Md. Ashif Islam Oni (*Lecturer, Faculty of Engineering, AIUB*), Dr. Mohammad Hasan Imam (*Senior Assistant Professor*, *Faculty of Engineering, AIUB),* Mr. Raja Rashidul Hasan (*Assistant Professor*, *Faculty of Engineering, AIUB*) and the participants along with the organizing team of AIUB Community of Engineering Students (ACES).

Lecture Session on "New Energy Technologies: Research and Innovation in Power and Energy"

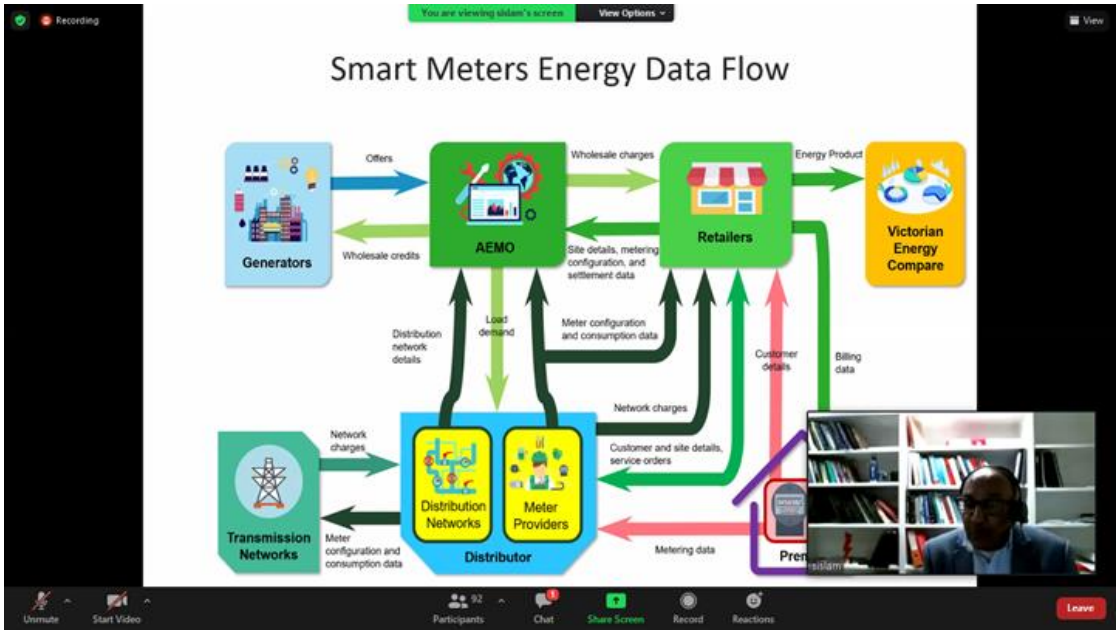
In the midst of the continuing COVID-19 situation, while everyone is locked down in their houses the IEEE AIUB Student Branch successfully organized the extremely enlightening distinguished lecture session titled *"New Energy Technologies: Research and Innovation in Power and Energy"* using the ZOOM Meeting platform on 29th July 2021. The focus of this lecture session was on the intersection of technological innovations, developmental objectives, and rising environmental concerns.

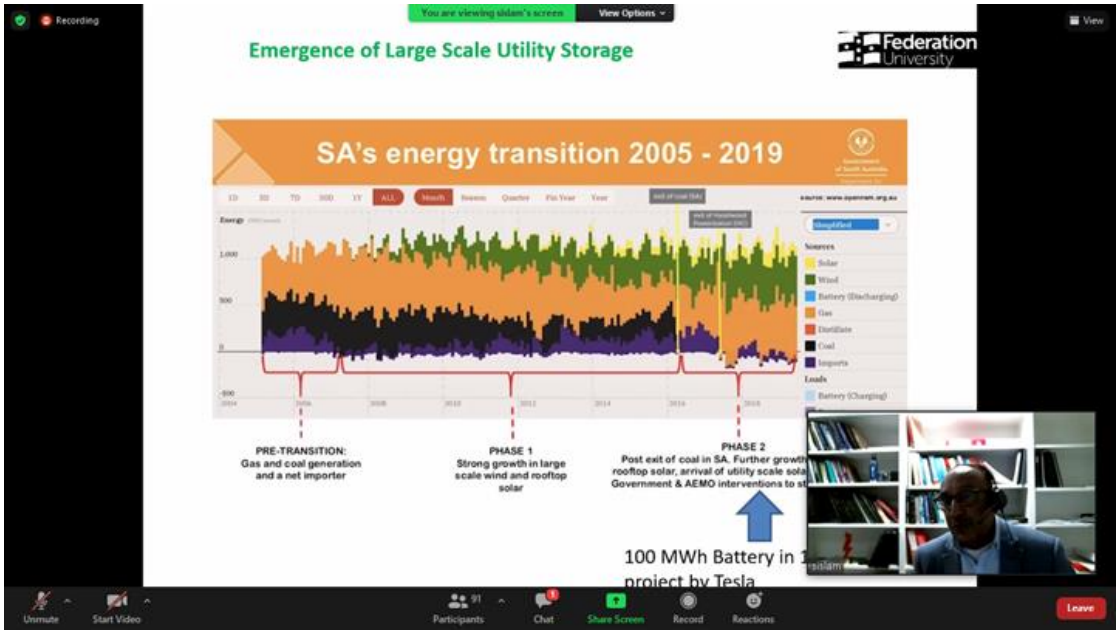
The session was inaugurated by Prof. Dr. ABM Siddique Hossain; *Dean, Faculty of Engineering, AIUB; Advisor, IEEE AIUB Student Branch;* who welcomed the respected Speaker of the session Prof. Syed Islam to the event. Prof. Hossain talked about the rapid technological changes in recent years and discussed the bad effects of coal in the atmosphere. He said that all the Engineers and Engineering students have a big role in this sector and as IEEE gives all the engineering students a platform for technological innovation and research, they have a big role to serve. The event was hosted by Dr. Mohammad Hasan Imam, *Counselor, IEEE AIUB Student Branch; Advisor, IEEE EMBS AIUB SB Chapter; Senior Assistant Professor, Faculty of Engineering, AIUB. Dr. Imam* introduced the prestigious IEEE AIUB Student branch in short to the honorable speaker Prof. Syed Islam, *Ph.D.; FIEEE, FIET, FIEAust, Eng Exec, CPEng, NPER, APEC Engineer, IEEE PES Distinguished Lecturer, Dean, School of Science, Engineering and Information Technology, Federation University Australia.*

The session was started with the opening remarks from Prof. Syed Islam. The honorable speaker started the session by showing his gratitude towards the IEEE AIUB Student Branch and the participants. The speaker started his presentation by showing the changes in the power grid. With examples, he briefly outlined the transition to the smart grid. Later, Prof. Islam talked about new energy, changing consumer preferences, policy, and regulatory forces, as well as data. Next, the speaker demonstrated smart homes, solar rooftops, control communication, and an advanced smart meter experiment to regulate transformer usage and assist with smart tariffs. He also mentioned Tesla's 100 days initiative, which includes a 100 MWh battery system. He also discussed the influence on ADMD and the efficiency of vehicle-to-grid (V2G). Finally, Prof. Islam concluded his speech by showing the IEC68150- communication in the digital substation.

Afterward, there was an interactive question-and-answer session, during which the speaker effectively addressed all of the questions. Later, Prof. Dr. Md. Abdur Rahman, *Associate Dean, Faculty of Engineering, AIUB; Advisor, IEEE AIUB Student Branch;* took the platform and presented the token of appreciation to the honorable speaker. And then he gave the concluding speech where he appreciated the initiative taken by the student branch to organize this distinguished lecture session and thanked the honorable speaker.

The session was graced by the presence of Prof. Dr. Mohammad Abdul Mannan, *Advisor, IEEE AIUB SB, Director, Faculty of Engineering, AIUB,* Mr. Nafiz Ahmed Chisy, *Associate Professor and Head-in-Charge (EEE), Faculty of Engineering, AIUB,* Mr. Md. Saniat Rahman Zishan, *Advisor, IEEE AIUB Student Branch, Associate Professor and Head (CoE), Faculty of Engineering, AIUB,* Mr. Chowdhury Akram Hossain, *Advisor, IEEE AIUB SB, Sr. Asst. Professor, Faculty of Engineering, AIUB*, Mr Kawshik Shikder, *Motivator, IEEE AIUB SB, Asst. Professor, Faculty of Engineering, AIUB*, and other faculty members and students from different universities along with executive branch members and volunteers.





Lecture Series on "Novel materials used for laser, photonics and renewable energy applications"

As a part of the "Dr. Anwarul Abedin Lecture Series", a regular initiative of the American International University-Bangladesh (AIUB), an informative webinar titled as "Novel materials used for laser, photonics and renewable energy applications" was held on 10 June 2021.The webinar was organized by the Faculty of Engineering in the honor of AIUB's visionary Founder Chairman Dr. Anwarul Abedin who catalyzed substantial transformation in the educational sector of the country. Distinguished speaker for the session was Dr. Yuen Hong TSANG, Associate Professor, Dept. of Applied Physics, The HongKong Polytechnic University. Dr. TSANG received his BSc and PhD in Physics from the School of Physics and Astronomy, The University of Manchester, UK in 2000 and 2004, respectively. Recently, Dr. Tsang was ranked in the top 2% of the world's most-cited scientists in the field of optoelectronics and photonics by Stanford University.

Dr ABM Siddique Hossain (Professor and Dean, Faculty of Engineering, AIUB) delivered an inspirational inauguration speech to the audience. He emphasized on AIUB's stand on prioritizing the importance of research and dissemination of information in Nanotechnology and Nanoscience, developing a technological hub to find the next breakthrough.

Dr. Yuen Hong TSANG was then provided with the floor to proceed with the session. He started with a brief description of 2-D materials and its prospects in novel devices for sensors, solar cells, saturable absorbers to name some. He highlighted the areas where key research attempts can be made and high citations can be achieved. He discussed in details about his recent works and how his research group has been characterizing novel 2-D materials to achieve saturable absorbers for ultra-fast lasers. The session ended with an interactive question answer session.

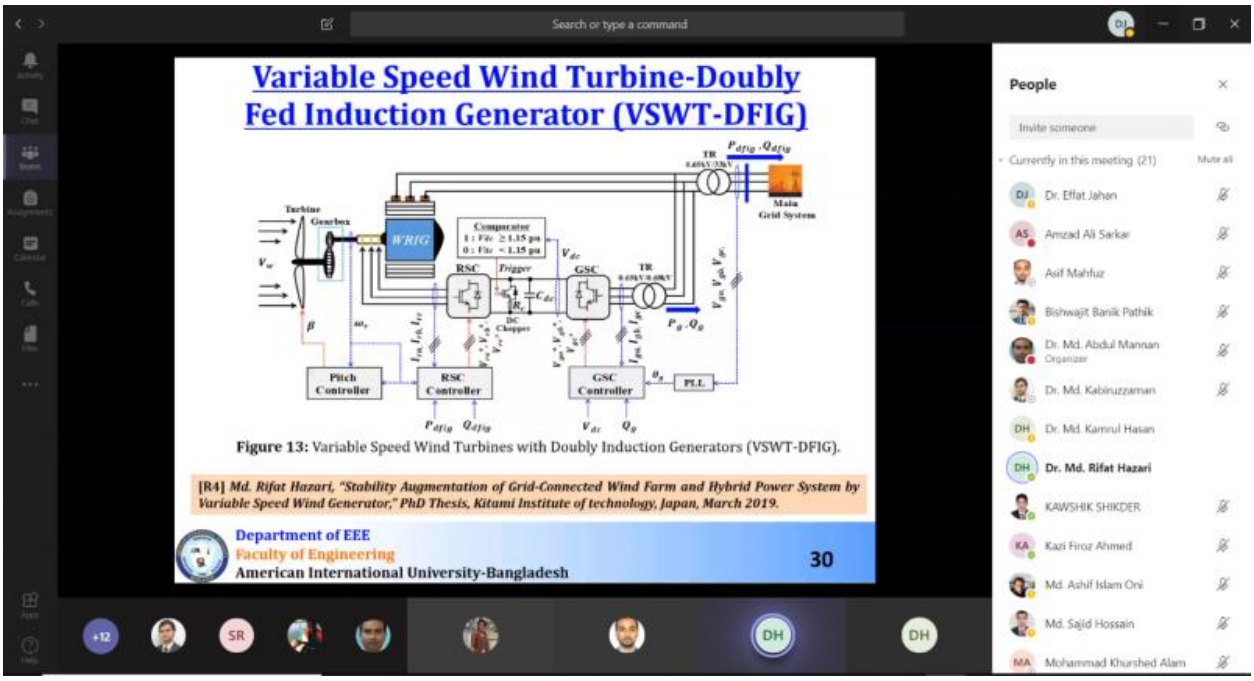
Prof. Dr. Md. Abdur Rahman (Associate Dean, Faculty of Engineering) provided the closing remarks by thanking Dr. Tsang for the informative session and invited him to collaborate in research activities with the Center for Nanotechnology Research of AIUB. Dr. Rahman then handed over the virtual token of appreciation to Dr. Tsang.

Assistant Professor and Special Assistant of Department of EEE, Mr. Tawsif Ibne Alam, acted as the moderator for the webinar. Faculty members, officials, students, alumni of AIUB and professionals from industry were present. With over 200 participants on the Zoom platform and more than 1500 views in Facebook, the webinar was indeed a success.

FACULTY OF ENGINEERING ORGANIZED A WORKSHOP ON POWER SYSTEM AND RENEWABLE ENERGY SIMULATION USING PSCAD/EMTDC SOFTWARE

Faculty of Engineering organized a workshop titled 'Power System and Renewable Energy Simulation using PSCAD/EMTDC Software' on Tuesday, April 28, 2020 at 2:00 PM in the Microsoft Teams online platform. 23 faculty members from Dept. of EEE attended this online workshop. The workshop was conducted by Dr. Md. Rifat Hazari, *Assistant Professor, Department of EEE, AIUB* who mainly focused on the necessity of renewable energy and hybrid power system research and how PSCAD/EMTDC software can be used for the hybrid power system simulation.

The workshop was inaugurated by the opening remarks from Prof. Dr. Mohammad Abdul Mannan, *Director, Faculty of Engineering, AIUB*. He discussed about the growing demand of renewable energy in the worldwide and challenges of grid integration issues of renewable energy. After that, the speaker Dr. Hazari took the stage and initiated the workshop by providing introduction to hybrid power system and how it works. Then he presented a tutorial on how to use PSCAD/EMTDC software. He briefed about the large number of advantages of hybrid power system, like less harmful to environment as renewable energy sources are used. He also discussed about renewable energy sources, scenarios of renewable energy in Bangladesh, challenges of hybrid power system, like difficulty to produce output power with high quality and reliability for synchronization with the local grid connection. After that, Dr. Hazari provided hands on expertise to the participants using PSCAD/EMTDC software. In the final part of the workshop participants modelled hybrid power system in PSCAD.The workshop ended with concluding remarks from Prof. Dr. Mannan where he highlighted the importance of this software in research and higher studies.



Workshop on Hybrid Power System Simulation Using PSCAD/EMTDC

Engineering Students' Association of Bangladesh (ESAB) AIUB Unit Face organized a workshop titled "Hybrid Power System Simulation Using PSCAD/EMTDC" at room number 3205, Annex-3, American International University-Bangladesh (AIUB). The purpose of this workshop was to provide an initial guideline about power system and show the students how to do simulation work in a power system. The program started with national anthem and a promo video of ESAB AIUB Unit Face. Afterwards Dr. Md. Rifat Hazari, (Assistant Professor, Dept. of EEE, Faculty of Engineering, AIUB) provided introductory remarks and thanked ESAB AIUB UF for organizing a useful workshop for the students.

The workshop was divided the workshop into two segments. In the first segment Dr. Hazari gave introduction to power system and how it works. Then he helped the students the students with a tutorial on how to use PSCAD / EMTDC. He briefed about the large number of advantages of hybrid power system, like less harmful to environment as renewable energy sources are used. He then briefly discussed about renewable energy sources and scenarios of renewable energy in Bangladesh. He discussed about challenges of hybrid power system, like difficulty to produce output power with high quality and reliability for synchronization with the local grid connection. Renewable energy sources are intermittent. The second segment started after lunch break where Dr. Hazari provided hands on expertize to the participants using PSCAD / EMTDC software. He discussed in detail how to use the software and how to do simulation. The students participated enthusiastically. In the final part of the workshop students modelled hybrid power system in PSCAD.

The workshop ended with concluding remarks from Prof. Dr. Md. Abdul Mannan (Director, Faculty of Engineering, AIUB). In his remarks Prof. Dr. Mannan highlighted the importance of this software in research and potential future prospects in higher studies abroad. He also thanked ESAB (AIUB) Unit Face for continually organizing informative workshops. Dr. Mannan then handed a crest and a certificate as a token of appreciation to the trainer, Dr. Hazari. Afterwards, Dr. Hazari provided certificate to the participants for successfully completing the workshop.

IEEE AIUB Student Branch organized the seminar titled, "Smart Power Grid in the 21st Century"

On 25th September 2019, IEEE AIUB Student Branch in collaboration with Department of EEE, Faculty of Engineering (FE) successfully organized a seminar titled "Smart Power Grid in the 21st Century" at the Multipurpose Hall of American International University-Bangladesh (AIUB). The seminar was inaugurated by Prof. Dr. A.B.M Siddique Hossain, *Dean, FE, AIUB; Advisor, IEEE AIUB Student Branch,* who discussed briefly the current power grid systems in Bangladesh, along with the necessities of implanting Smart power grids. He concluded his speech by encouraging the students to set their aims to smart power sectors due to its gradual increase in demand, illustrating different projects related to power, that the government has taken for the upcoming years.

The keynote speaker, Prof. Akhtar Kalam, *Professor of Electrical Engineering Department, Victoria University*, *Australia*, came up on stage after a warm invitation from the Dean. His session by discussing the power sector of Bangladesh in the past and addressed sufferings that people used to have during those times. Later, he elaborately discussed the current conditions of the Power grid systems of Bangladesh and appreciated the way, the power sectors have successfully evolved in recent times compared to the past. In addition, Prof. Kalam identified the point that day by day the power demands in the world are increasing drastically compared to which the capacity isn't getting upgraded. He also discussed the importance of Technology, Business, and Markets for precisely shaping the future, along with the three pillars of third industrial revolution including- Renewable energy, Storage technology, and the Smart Power Grid system. Therefore, for solving this issue, he explained "Smart Power Grid systems" in deep with multiple beneficial factors over "Old Power Grid systems". Later, he elaborately discussed the principal characteristics of "Smart Power Grid systems" along with its advantageous factors including- the improvements on reliability, efficiency levels, safety, environment-friendly, reduce unemployment and many more. Before concluding his speech, he made a tentative visual representation of how the smart power grid systems will look compared to the older one including the integration of renewables, electric vehicles, demand response, as well as reliability and efficiency. Later, Rolf Boum, *International Recruitment Manager, Engineering Institute of Technology (EIT)-Australia,* took the stage and introduced EIT to the attendees, including their achievements, their past and upcoming initiatives in collaboration with well-known companies of the world. He also talked about tuition fees structure, available scholarships for postgraduate programs that EIT offers to their students and explained the curriculum in detail. He concluded his presentation by displaying some pictures that portray their highly equipped virtual labs. Lastly, to conclude the event, Dr. Md. Hasan Imam, *Counselor, IEEE AIUB Student Branch; Senior Asst. Professor, FE, AIUB,* took the stage. He started by addressing to the smart city movements and implementations in Australia and shared his experience of getting a doctorate in Australia with the attendees. Later, he thanked the speakers for their informative and interactive event.

He finally concluded the event by handing over tokens of appreciation with the honorable Dean, which included certificates and crests, to the honorable speakers of the session. The event was graced by the presence of Md. Nahian Al Subri Ivan, *Asst. Professor, FE*, Rethwan Faiz, *Asst. Professor, FE*, Mehedi Hasan, *Asst. Professor, FE*, Dr. Md. Rifat Hazari, *Asst. Professor, FE*, S. M. Imrat Rahman, *Asst. Professor, FE*, Dr. Effat Jahan, *Asst. Professor, FE*, Md. Ashif Islam Oni, *Lecturer, FE*, Tasnuva Tasneem*, Motivator and WIE Coordinator, IEEE AIUB Student Branch, Asst. Professor, FE,* and Kawshik Shikder, *Motivator, IEEE AIUB Student Branch; Advisor, IEEE Microwave Theory and Techniques Society (MTTS) AIUB SB Chapter; Asst. Professor, FE, AIUB.*

DEPARTMENT OF EEE IN COLLABORATION WITH IEEE AIUB STUDENT BRANCH AND DEPARTMENT OF PHYSICS ORGANIZED A SEMINAR ON "ADVANTAGES OF NUCLEAR POWER FOR BANGLADESH"

Department of Electrical and Electronic Engineering (EEE) in collaboration with IEEE AIUB Student Branch and Department of Physics successfully organized a seminar on "Advantages of nuclear power for Bangladesh" at American International University-Bangladesh. The seminar mainly focused on nuclear power plants including its advantages and future in Bangladesh. The seminar was conducted by Prof. Dr. Afroza Shelley, *Doctor of Nuclear Engineering; Professor, Department of Physics, AIUB*, Prof. Dr. Shafiqul Islam Bhuiyan, *Former Chairman, Bangladesh Atomic Energy Commission*, Engr. M Ali Zulquarnain, *Former Chairman, Bangladesh Atomic Energy Commission* and Prof. M. A. Quaiyum, *Former Chairman, Bangladesh Atomic Energy Commission; Professor, Department of EEE, AIUB*.

The seminar was inaugurated by the opening remarks of Prof. Dr. Tafazzal Hossain, *Pro Vice Chancellor, Dean in Charge, Faculty of Science and Technology, AIUB* who discussed the importance of nuclear energy and power plants in recent times. Later he encouraged the students to show interests in nuclear power sector in future.

The first speaker of the seminar, Engr. M Ali Zulquarnain, *Former Chairman, Bangladesh Atomic Energy Commission* took the stage and shared his experiences as well as discussed the future of nuclear energy in the world. During his presentation, he mainly focused on modern nuclear reactors, especially its basic constructions, working principles and its advantages. Later, he discussed about major nuclear accidents in the past along with its causes and consequences. He concluded his presentation by sharing some construction photographs of *Rooppur Nuclear Power Plant*.

Then the second speaker for the session Prof. Dr. Shafiqul Islam Bhuiyan, *Former Chairman, Bangladesh Atomic Energy Commission*, took the stage and discussed about the future of nuclear power. During his presentation, he mainly focused on modern VVER or water-water energy reactors (generation III+) – its basic structures, performance and advantages of using this sort of reactor. He concluded his presentation by briefly discussing about the working process of a power plant including its active & passive safety systems, filtration systems, hydrogen removal systems and many more.

Prof. M. A. Quaiyum, *Former Chairman, Bangladesh Atomic Energy Commission; Professor, Department of EEE, AIUB* later elaborately discussed about the advantages of nuclear power plants, its current and future demands along with the benefits that will be provided by *Rooppur Nuclear Power Plant*. He concluded his presentation by encouraging the students for studying nuclear energy in future by mentioning the wide range of facilities provided in this sector.

Later on, the keynote speaker Prof. Dr. Afroza Shelley, *Doctor of Nuclear Engineering, Professor, Department of Physics, AIUB* discussed about the current status of electrical power in Bangladesh along with its demand and generation. Then, she briefly discussed about some interesting facts of nuclear energy, including nuclear fusion reactions, nuclear fission chain reactions and fission products. In addition, Prof. Dr. Afroza Shelley discussed about nuclear reactor fuels such as Uranium, Thorium – its cost, its current reserves in the world and the methods of producing it. Moreover, she gave a brief idea about spent fuels mainly its compositions and discussed the ways of restoring it to retain its activity. Before concluding her presentation, she gave some interesting and important information regarding *Rooppur Nuclear Power Plant* including its location, cost, capacity and its properties.

Later, Dr. Md. Hasan Imam, *Counselor, IEEE AIUB Student Branch; Education Activity Coordinator, IEEE Bangladesh Section Computer Society Chapter; Advisor, IEEE Engineering in Medicine and Biology Society AIUB Chapter; Senior Assistant Professor, Department of EEE, Faculty of Engineering, AIUB,* gave a short closing speech. In his speech he thanked IEEE AIUB Student Branch and Department of Physics for organizing this seminar. The event was graced by Prof. Dr. A.B.M Siddique Hossain, *Advisor, IEEE AIUB Student Branch, Dean, Faculty of Engineering, AIUB*, Dr. Humayra Ferdous*, Head in Charge, Department of Physics, AIUB* and Kawshik Shikder, *Motivator, IEEE AIUB Student Branch; Advisor, IEEE Microwave Theory and Techniques Society AIUB SB Chapter; Assistant Professor, Faculty of Engineering, AIUB.*

Seminar on "Grid Connected Renewable Energy Sources: Stability Challenges, Research and Higher Study Opportunities"

On 11th April 2019, IEEE AIUB Student Branch in association with IEEE Industrial Application Society AIUB Student Branch Chapter, successfully organized a seminar on "Grid Connected Renewable Energy Sources: Stability Challenges, Research and Higher Study Opportunities" at American International University-Bangladesh. The seminar focused on various aspects of renewable energy sources and how they can be connected to grid transmission and distribution. The seminar was conducted by Dr. Md. Rifat Hazari*, Assistant Professor, Department of Electrical and Electronic Engineering, Faculty of Engineering, AIUB*, who has great expertise in this field.

The event was inaugurated by Dr. Mohammad Hasan Imam, *Counselor, IEEE AIUB Student Branch; Advisor, IEEE Engineering in Medicine and Biology Society AIUB Chapter; Education Activity Coordinator, IEEE Bangladesh Section Computer Society Chapter; Senior Assistant Professor, Department of Electrical and Electronic Engineering, Faculty of Engineering, AIUB, who initiated his speech by portraying the problems of the use of fossil fuels and their combustion. He also included the use of solar and other renewable alternatives in energy production. He concluded the speech by describing the distribution and transmission of power through active grid systems.*

After the inauguration, the speaker of the seminar, Dr. Md. Rifat Hazari initiated his session by illuminating the students about the basic types of renewable energy sources and their usefulness and efficiencies. He also discussed about the comparison of wind and solar energy along with major statistics of their use worldwide. He said that renewable energy sources will hold a major significance in Bangladesh in the coming future. A brief summary of wind turbines along with his own thesis proposal were shown to the participants. The speaker concluded his segment with a question and answer session.

The concluding speech was given by Dr. Mohammad Hasan Imam, who further talked about how informative the session was and he thanked the speaker for conducting such an event and also addressed the opportunities that these types of sessions can provide to the students. Later he provided crest and token of appreciation to the honorable speaker. Afterward, a photo session with the participants took place which marked the end of the seminar. The seminar was graced by the presence of Tasnuva Tasneem, *Motivator, IEEE AIUB Student Branch; Coordinator, IEEE AIUB Student Branch WIE Affinity Group; Assistant Professor, Faculty of Engineering, AIUB.*


Seminar on
Grid-Connected Renewable Energy Sources: Stability Challenges, Research and Higher Study Opportunities
Date & Time
3:00-5:00 PM
10th April, 2019
Room #3210
American International University-Bangladesh
Speaker


Seminar on
Grid-Connected Renewable Energy Sources: Stability Challenges, Research and Higher Study Opportunities


Thank You
for
your attention
Seminar on
Grid-Connected Renewable Energy Sources: Stability Challenges, Research and Higher Study Opportunities

Faculty Research and Publication

A Study on Bangladesh Power System Fault Level Management

Author: MOHAMMAD KHURSHED ALAM et al.

Brief Description:

Future's generation and load planning of Bangladesh illustrates rapid development of power system in upcoming year which shows many new generating stations as well as transmission lines are going to be installed. This implies that the fault current level at substation buses will further increase and forces transformers, switchgear and other equipment to operate near their thermal or stability limit. Due to the expansion and more interconnected grid system the fault current levels increase beyond the capabilities of the existing equipment. So, this is the high time to put attention on fault level management of Bangladesh power system. There are different passive techniques like current limiting reactor (CLR), neutral grounding policy (NGR), network & bus splitting to retain the fault current within a acceptable range. This paper takes two substations of Bangladesh power system of higher fault level under consideration and discusses about the different passive techniques to reduce the fault level. Here the load flow and short circuit studies were carried out using Digsilent Power Factory software to find the way to manage the fault level of Bangladesh power system.

Source: https://ieeexplore.ieee.org/document/8975514

Voltage Performance Analysis with Integration of Utility Scale Solar PV Plant in Bangladesh National Grid

Author: MOHAMMAD KHURSHED ALAM et al.

Brief Description:

The aim of this paper is to analyze the voltage performance due to integration of an utility scale Solar Photovoltaic Generation (SPVG) in Bangladesh national grid. Voltage profile in a power system is a major concern for supplying quality power to consumers. Integration of SPVG in a relatively weaker part of a grid may require reactive power compensation to retain acceptable voltage level. In this paper, detailed investigations are carried out to explore the impact of 8 MW SPVG at a 33 kV bus of northern zone of Bangladesh power system. In addition, static voltage stability analysis is executed using continuation power flow method. Afterwards, reactive power compensation is done using capacitor bank to maintain the required voltage to integrate SPVG to the grid. All the simulations are performed based on practical operating scenarios of Bangladesh power system using DIgSILENT Power Factory software.

Source: https://ieeexplore.ieee.org/document/9230639

A Combined Approach of Connecting Small Energies to Meet the Challenges of Developing Countries

Author: MOHAMMAD KHURSHED ALAM et al.

Brief Description:

To maintain the developments of the current competing world need enormous amount of energy as a form of electrical energy. A number of methods are proposed and implemented to meet the challenges of the electric power generation. This paper aims to propose a combined electric generation process from the wastage, basically in the developing countries. The main contribution of this paper is to show the way to combine several interconnected process that can be implemented for the electric power generation. The framework is solely designed for a developing country like Bangladesh to mitigate its future uprising requirement of the energy. The proposal is designed for the consideration of the future ecology, too. Eventually, this proposal will provide guidelines for the decision makers of a developing country for power generation with making their environment clean.

Source: https://ieeexplore.ieee.org/document/9242988

Fault Characteristic of a Power Transformer in Bangladesh Power Grid

Author: MOHAMMAD KHURSHED ALAM et al.

Brief Description:

Faults in an electric power system hinder the sustainability and longevity of power system components. Protective devices should be well coordinated for rapid removal of fault. Transformers are expensive and critical equipment and requires full-fledge protection to ensure operational reliability. Grid transformer failure may result in a brownout of an area. This paper focuses on a power transformer fault that occurred in the Bangladesh power grid, analyses characteristics of the fault, and suggests modifications to the existing protection scheme.

Source: https://ieeexplore.ieee.org/document/9393158

In situ Oriented Mn Deficient ZnMn2O4@C Nanoarchitecture for Durable Rechargeable Aqueous Zinc-ion Battery

Author: Dr. Saiful Islam et al.

Brief Description:

Manganese (Mn)-based cathode materials have garnered huge research interest for rechargeable aqueous zinc-ion batteries (AZIBs) due to the abundance and low cost of manganese and the plentiful advantages of manganese oxides including their different

structures, wide range of phases, and various stoichiometries. A novel in situ generated Mn-deficient ZnMn2O4@C (Mn-d-ZMO@C) nanoarchitecture cathode material from self-assembly of ZnO-MnO@C for rechargeable AZIBs is reported. Analytical techniques confirm the porous and crystalline structure of ZnO-MnO@C and the in situ growth of Mn deficient ZnMn2O4@C. The Zn/Mn-d-ZMO@C cell displays a promising capacity of 194 mAh g−1 at a current density of 100 mA g−1 with 84% of capacity retained after 2000 cycles (at 3000 mA g−1 rate). The improved performance of this cathode originates from in situ orientation, porosity, and carbon coating. Additionally, first-principles calculations confirm the high electronic conductivity of Mn-d-ZMO@C cathode. Importantly, a good capacity retention (86%) is obtained with a year-old cell (after 150 cycles) at 100 mA g−1 current density. This study, therefore, indicates that the in situ grown Mn-d-ZMO@C nanoarchitecture cathode is a promising material to prepare a durable AZIB.

Source: https://onlinelibrary.wiley.com/doi/10.1002/advs.202002636

Title: Manganese and Vanadium Oxide Cathodes for Aqueous Rechargeable Zinc-ion Batteries: A Focused View on Performance, Mechanism and Developments.

Author: Dr. Saiful Islam et al.

Brief Description:

The development of new battery technologies requires them to be well-established given the competition from lithium ion batteries (LIBs), a well-commercialized technology, and the merits should surpass other available technologies' characteristics for battery applications. Aqueous rechargeable zinc ion batteries (ARZIBs) represent a budding technology that can challenge LIBs with respect to electrochemical features because of the safety, low cost, high energy density, long cycle life, high-volume density, and stable water-compatible features of the metal zinc anode. Research on ARZIBs utilizing mild acidic electrolytes is focused on developing cathode materials with complete utilization of their electro-active materials. This progress is, however, hindered by persistent issues and consequences of divergent electrochemical mechanisms, unwanted side reactions, and unresolved proton insertion phenomena, thereby challenging ARZIB commercialization for large-scale energy storage applications. Herein, we broadly review two important cathodes, manganese and vanadium oxides, that are witnessing rapid progress toward developing state-of-the-art ARZIB cathodes.

Source: https://pubs.acs.org/doi/10.1021/acsenergylett.0c00740

Quasi-solid-state zinc-ion battery based on α-MnO2 cathode with husk-like morphology.

Author: Dr. Saiful Islam et al.

Brief Description:

Zinc-ion batteries (ZIBs) are very promising energy storage devices owing to their safety, environmental friendliness, and low-costs. Nevertheless, their development has been mostly focused on aqueous-based systems. We fabricated a quasi-solid-state ZIB based on α-MnO2 nanohusk morphology synthesized using a one-step hydrothermal method and gel electrolyte. The fabricated quasi-solid-state ZIB exhibited a high initial discharge capacity of 321 mA h g−1 at a current density of 33 mA g−1 and considerable cyclability. We systematically investigated its electrochemical properties utilizing various characterization methods such as cyclic voltammetry and galvanostatic intermittent titration technique. In addition, in-situ synchrotron X-ray diffraction and X-ray absorption spectroscopy were used to elucidate the phase transformation of the cathode in the quasi-solid-state ZIB upon electrochemical cycling. This study may provide further insight into electrochemical behaviour of the quasi-solid-state ZIB based on the α-MnO2 nanohusk morphology and gel electrolyte as a promising energy storage device.

Source: https://www.sciencedirect.com/science/article/abs/pii/S0013468620305818

The dominant role of Mn2+ additive on the electrochemical reaction in ZnMn2O4 cathode for aqueous zinc- ion batteries

Author: Dr. Saiful Islam et al.

Brief Description:

Among zinc-ion battery (ZIB) cathodes, ZnMn2O4 (ZMO), with its high theoretical capacity and voltage, is an intriguing choice. In this study, we compared the electrochemical activity of a ZMO microrods cathode obtained through a simple co-precipitation process in the presence of a 0.1 M MnSO4 (MS) solution as a full-time electrolyte, as an additive in zinc sulfate (ZMS) electrolyte (1 M ZnSO4 + 0.1 M MnSO4) and in its absence or a full-time zinc sulfate (ZS) electrolyte (1 M ZnSO4), respectively. Systematic investigations including ex situ X-ray diffraction (XRD), scanning electron microscopy (SEM), and transmission electron microscopy (TEM) studies revealed the reasons for the superior stability and high reversibility of ZMO in the ZMS electrolyte medium. The exceptional performance was facilitated by the electrochemical equilibrium between Zn2+ and Mn2+ ions via a stable Zn2+ (de)insertion in the bulk, a reversible electro-deposition/dissolution of MnOx from the Mn2+ additive in the electrolyte onto(from) the surface of the cathode and the reversible Zn-insertion into the undissolved surface MnOx layer. This finding is significant as it is contrary to the conventional understanding that the addition of Mn2+ merely tends to prevent manganese dissolution thereby facilitating a stable cycle-life performance of the cathode in ZIBs.

Source: https://www.sciencedirect.com/science/article/abs/pii/S2405829719310992

First principles calculations study of α-MnO2 as a potential cathode for Al-ion battery application

Author: Dr. Saiful Islam et al.

Brief Description:

α-MnO2 is considered as an attractive cathode material for lithium, sodium and magnesium-ion battery applications because of its relatively large [2 × 2] tunnel, high discharge capacity, environmental benignity and low cost. Therefore, understanding the electrochemical properties of α-MnO2 for eco-friendly trivalent aluminum-ion battery is of great research interest. Herein, we presented a theoretical study of Al insertion into α-MnO2 using first principles calculations based on the density functional theory. We found that Al insertion into α-MnO2 proceeded through 4 insertion stages. The average calculated voltage was found to be 1.55 V. Moreover, our calculations suggested the structural distortion of α-MnO2 upon Al insertion even in the dilute limit of insertion. In addition, the electronic properties of the Al-inserted phases and the effect of the metal doping strategy in α-MnO2 for performance improvement were also discussed. Our study may provide an insight and pave the way for further applications of α-MnO2 as an electrode material and potential insertion host for aluminum-ion batteries.

Source: https://pubs.rsc.org/en/content/articlelanding/2019/ta/c9ta09321d#!divAbstract

K + intercalated V2O5 nanorods with exposed facets as advanced cathodes for high energy and high rate zinc-ion batteries.

Author: Dr. Saiful Islam et al.

Brief Description:

Aqueous rechargeable zinc-ion batteries (ARZIBs) have drawn enormous attention because of their low-cost and eco-friendly cell components. However, designing high-performance cathode materials towards practical application of ARZIBs remains a major challenge. Therefore, in this contribution, a comprehensive study on K+ intercalated V2O5 (KVO) nanorods with exposed facets as a high-performance cathode for ARZIBs is presented. The KVO cathode exhibits remarkable discharge capacities of 439 and 286 mAh g−1 at current densities of 50 and 3000 mA g−1, respectively. Furthermore, it recovers 96% of the capacity after 1500 cycles at 8000 mA g−1. Impressively, the Zn/KVO battery offers a specific energy of 121 W h kg−1 at high specific power of 6480 W kg−1. The storage mechanism of the KVO cathode in an ARZIB is systematically elucidated using in operando synchrotron X-ray diffraction, ex situ synchrotron X-ray absorption spectroscopy, ex situ TEM analyses and first-principles calculations. The superior performance of the cathode is attributed to its unique exposed layer structure with high surface energy, high conductivity and low migration barrier for Zn2+ migration. This study provides insight into designing high-performance cathode materials for ARZIBs and other electrochemical systems.

Source: https://pubs.rsc.org/en/content/articlelanding/2019/ta/c9ta05767f#!divAbstract

A new rechargeable battery based on a zinc anode and a NaV6O15 nanorod cathode.

Author: Dr. Saiful Islam et al.

Brief Description:

We explore NaV6O15 (NVO) nanorod cathodes prepared by a sol–gel method for aqueous rechargeable zinc-ion battery applications for the first time. The NVO cathode delivers a high capacity of 427 mA h g−1 at 50 mA g−1 current density. Furthermore, based on the mass of the active materials, it exhibits a high energy density of 337 W h kg−1.

Source: https://pubs.rsc.org/en/content/articlelanding/2019/cc/c9cc00897g#!divAbstract

Stabilization Control of Power System with Large-Scale Wind Farm by Using DFIG Considering Grid Codes

Author: Dr. Md. Rifat Hazari et al.

Brief Description:

This paper proposes an innovative operational scheme for a grid-connected large-scale wind farm (WF) which is composed of both fixed speed wind turbines with squirrel cage induction generators (FSWT-SCIGs) and variable speed wind turbine with doubly fed induction generators (VSWT-DFIGs). Normally, SCIG cannot fulfil the necessities of fault ride-through (FRT), because of the insufficient amount of reactive power supply during transient condition which may leads to the instability of the power system. Thus, in this paper, a new technique is proposed to stabilize SCIG by using DFIG in a grid-connected WF. A novel fuzzy logic controller (FLC) based rotor side controller is proposed for VSWT-DFIG to improve the FRT capability of FSWT-SCIG-based WF and transient stability of entire power system. The proposed FLC is designed in order to inject effective amount of reactive power during fault condition. The effectiveness of the proposed control strategy is verified through simulation analyses on a multi-machine power system model in PSCAD/EMTDC software. Additionally, the transient stability of the entire power system is evaluated by using the transient stability index.

Source: https://ieeexplore.ieee.org/document/8644524

Damping of Frequency Fluctuations of Hybrid Power System by Variable Deloaded Operation of PMSG Based Offshore Wind Farm

Author: Dr. Md. Rifat Hazari et al.

Brief Description:

This paper focuses on a novel variable deloaded operation of variable speed wind turbines with permanent magnet synchronous generators (VSWT-PMSGs) based offshore wind farm (OWF) to maintain primary reserve, which is connected to onshore grid through voltage source converter based high voltage DC (VSC-HVDC) transmission system. A centralized droop controller with dead band is designed for VSWT-PMSGs to utilize this reserve power to suppress the frequency fluctuations of the onshore grid due to the installations of large-scale fixed speed wind turbines with squirrel cage induction generators (FSWT-SCIGs) based wind farm (WF) and photovoltaic (PV) power station. The combination of variable deloaded operation and centralized droop controller can give better frequency regulation and decrease energy loss due to the deloaded operation. The effectiveness of the proposed variable deloaded operation and centralized droop controller is verified through simulation analyses on a modified IEEE nine-bus test system. The simulation results reveal that the variable deloaded operation can decrease the energy loss compared to the fixed deloaded operation as well as suppress the frequency fluctuations in the same level as the fixed deloaded operation.

Source: https://www.jstage.jst.go.jp/article/ieejpes/139/4/139_259/_article/-char/en

Primary Frequency Regulation of the Hybrid Power System by Deloaded PMSG-based Offshore Wind Farm using Centralised Droop Controller

Author: Dr. Md. Rifat Hazari et al.

Brief Description:

This paper proposes a coordinated frequency control method for variable speed wind turbines with permanent magnet synchronous generators (VSWT-PMSGs) based offshore wind farm (OWF), which is connected to the main onshore grid through voltage source converter (VSC) based high voltage DC (HVDC) transmission system. The purpose of the proposed system is to damp the frequency oscillations of the onshore grid due to the installation of large-scale fixed speed wind turbines with squirrel cage induction generators (FSWT-SCIGs) based wind farm (WF) and photovoltaic (PV) power station. A novel centralised droop controller with the dead band is designed for VSWT-PMSGs to decrease the frequency fluctuations of the onshore main power system. In the proposed system, primary frequency reserve is implemented by deloading operation of VSWT-PMSGs in the OWF. The effectiveness of the proposed centralised frequency controller is verified through simulation analysis on a modified IEEE nine-bus model system in PSCAD/EMTDC software.

Source: https://digital-library.theiet.org/content/journals/10.1049/joe.2018.9326

Coordinated Control Scheme of Battery Storage System to Augment LVRT Capability of SCIG-Based Wind Turbines and Frequency Regulation of Hybrid Power System

Author: Dr. Md. Rifat Hazari et al.

Brief Description:

Fixed speed wind turbine-squirrel cage induction generator (FSWT-SCIG)-based wind farms (WFs) are increasing significantly. However, FSWT-SCIGs have no low voltage ride-through (LVRT) and frequency control capabilities, which creates a significant problem on power system transient and steady-state stability. This paper presents a new operational strategy to control the voltage and frequency of the entire power system, including large-scale FSWT-SCIG-based WFs, by using a battery storage system (BSS). The proposed cascaded control of the BSS is designed to provide effective quantity of reactive power during transient periods, to augment LVRT capability and real power during steady-state periods in order to damp frequency fluctuations. The cascaded control technique is built on four proportional integral (PI) controllers. The droop control technique is also adopted to ensure frequency control capability. Practical grid code is taken to demonstrate the LVRT capability. To evaluate the validity of the proposed system, simulation studies are executed on a reformed IEEE nine-bus power system with three synchronous generators (SGs) and SCIG-based WF with BSS. Triple-line-to-ground (3LG) and real wind speed data are used to analyze the hybrid power grid's transient and steady-state stability. The simulation results indicate that the proposed system can be an efficient solution to stabilize the power system both in transient and steady-state conditions. View Full-Text

Source: https://www.mdpi.com/2079-9292/9/2/239

Hybrid Power System Frequency Control including Wind Farm using Battery Storage System

Author: Dr. Md. Rifat Hazari et al.

Brief Description:

Fixed speed wind turbine-squirrel cage induction generator (FSWT-SCIG) based wind farm (WF) is increasing significantly. However, FSWT-SCIG have no frequency control capability, which creates a significant problem on power system steady-state stability. This paper represents a new operational strategy to control frequency of the entire power system including large-scale FSWT-SCIG based WF by using battery storage system (BSS). The proposed cascaded control of BSS is designed to provide effective amount of real power during steady-state period to damp frequency fluctuations. To evaluate the validity of the proposed system, simulation studies are executed on a reformed IEEE nine-bus power system with three synchronous generators (SGs)

and SCIG-based WF along with BSS. The simulation results indicate that the proposed system can be an effective solution to reduce frequency fluctuations of the hybrid power system during steady-state condition.

Source: https://ajse.aiub.edu/index.php/ajse/article/view/56

Augmentation of DC-Link Protection System of PMSG Based Wind Turbine Using Fuzzy Logic Controlled Buck Controller System

Author: Dr. Md. Rifat Hazari et al.

Brief Description:

Recently, permanent magnet synchronous generator (PMSG) is one of the most familiar type of generator for wind power plant (WPP). Generally, PMSG is connected to gird using back to back converter. During fault period, power imbalance situation is happened between machine side and gird converter. As a result, the DC-link voltage can be rise significantly which can damage the whole converter system. In this paper, a novel DC-Link protection system of buck converter based on fuzzy logic is designed in order to augment the transient stability of the PMSG system. The new buck converter along with its control system is designed to manage the supplied voltage of the braking resistor during fault period. For investigating the performance of the proposed system, fault analysis is performed on different case scenarios PSCAD/EMTDC software.

Source: https://ajse.aiub.edu/index.php/ajse/article/view/88

A Robust Virtual Inertia Control of Battery Storage System to Enhance Transient Stability of Grid System including Wind Farms

Author: Dr. Md. Rifat Hazari et al.

Brief Description:

With the rising penetration of modern converter-based wind farm (WF) into the existing grid system deteriorates system inertia due to reduction of the capacity of conventional power stations which may lead to the frequency instability as well as power system transient instability. In order to solve this concern, this paper presents a robust virtual inertia control approach for battery storage system (BSS) to enhance the frequency stability of the grid system after the generation failure owing to severe grid disruption. The control approach integrated inertial

controller based on the rate of change of frequency (ROCOF) and droop controller according to frequency deviation. The impacts of the proposed virtual inertia controller (VIC) is confirmed through simulation analysis on a multi-machine power system with conventional power stations, permanent magnet synchronous generator (PMSG) with full converter based WF and squirrel cage induction generator (SCIG) based WF. Simulation study clearly demonstrates that by adopting both strategies, the BSS can effectively minimize the frequency nadir and steady-state error.

Source: https://ajse.aiub.edu/index.php/ajse/article/view/113

A Robust Control Strategy to Improve Low Voltage Ride-Through of a Grid-Connected Photovoltaic System

Author: Dr. Md. Rifat Hazari et al.

Brief Description:

In this paper, a robust control approach is developed to enhance the transient stability and low-voltage ride-through (LVRT) competence of a grid-connected large-scale solar photovoltaic (PV) plant. The modern grid codes are demanded that the PV plant should provide dynamic support. The proposed control policy can guarantee the LVRT aptitude in accordance with grid codes and power system transient stability against symmetrical and unsymmetrical faults. Besides, a DC-link protection system, AC–DC converter, and DC– AC converter controllers are developed. To analyse the performance of the proposed strategy under different faults, simulation is performed on a customized IEEE nine-bus system including conventional synchronous generator (SG)-based power plants and a PV plant using PSCAD/EMTDC software. Additionally, a comparative study is shown with the conventional control strategy. The simulation analysis shows that PV plant terminal voltage is recovered 90% of its nominal value within 1.5 s, which implies that the LVRT aptitude and transient stability can be enhanced by integrating the proposed strategy.

Source: https://www.actapress.com/Abstract.aspx?paperId=54132

LVRT Performance Analysis and Transient Stability Augmentation of a Grid-Tied PV System

Author: Dr. Md. Rifat Hazari et al.

Brief Description:

The incorporation of renewable energy technologies such as photovoltaic (PV) systems into traditional electrical grid networks is a difficult challenge because of their unreliable form of producing electricity. The challenge includes the disconnection of PV system from the grid under

fault condition, which further leads to instability in the grid integrated PV system and results in system wide power outages. The PV system must remain attached with the grid under fault condition according to modern low voltage ride through (LVRT) grid codes and support in a similar manner as conventional plants. Therefore, in this paper, four different types of control strategies are designed and analyzed to improve LVRT capability of PV station. The comprehensive simulation of the grid-tied large-scale PV station is conducted using PSCAD/EMTDC to assess the feasibility of the suggested control scheme.

Source: https://ieeexplore.ieee.org/document/9331231

Solar Photovoltaic-Based Smart Metering System

Author: Dr. Md. Rifat Hazari et al.

Brief Description:

In the modern era demand for energy is growing gradually, but the sources are limited to provide that much energy. To convince the increasing demand for energy, new sources are needed to be found and take the renewable energy in the count as source and allocate the efficiently. This paper aims to reduce the usage of grid electricity by proposing a solar photovoltaic (PV)-based smart metering system. The system consists of solar dc power which can be converted into ac power by using grid inverter. Both grid and solar supply information will be given to the microcontroller and supply will be selected automatically according to the requirement of the appliances. Finally, voltage, current and power consumption parameters will be displayed on an LCD monitor and controlled using GSM module.

Source: https://ieeexplore.ieee.org/document/9331098

Analysis of a Hybrid Power System Including Large-Scale Wind Farm

Author: Dr. Md. Rifat Hazari et al.

Brief Description:

Integration of large-scale grid-tied wind farm (WF) has been rising since the last decade. Most of the WF are built using squirrel cage induction generator (SCIG). In this paper, an analysis has been done on the hybrid power system model contained of conventional power plants and SCIG. The analysis has been done on different parameters of the grid system, i.e., voltage, active, and reactive power, and frequency. Real wind speed data is applied in this work to make realistic response. Simulation has been conducted using PSCAD/EMTDC software.

Source: https://ieeexplore.ieee.org/document/9331117

Fuzzy Logic Controlled DC-Link Protection Scheme of PMSG Based Wind Turbine

Author: Dr. Md. Rifat Hazari et al.

Brief Description:

Usually, Permanent magnet synchronous generator (PMSG) based wind turbine supplies power to the grid using a back-to-back converter system. Any fault in the transmission system may result in power imbalance between the converters, which causes a significant voltage to rise in the DC-Link system, which may damage the converter system and hamper the transient stability of the system. A breaking resistor based conventional protection system is used to protect the converter system. However, this protection system cannot dissipate the excess power if it exceeds the power dissipation ability of breaking resistor. To get rid of this problem a fuzzy logic-based protection system for DC-Link circuit is offered in this paper to enhance the power dissipation ability of breaking resistor and improve transient stability of the system. Simulation results prove that proposed protection method can improve the power dissipation ability of the breaking resistor and transient stability of the system compared to conventional protection system.

Source: https://ieeexplore.ieee.org/document/9331167

Design and Simulation of a Dual Rotor Wind Turbine based PMSG System

Author: Dr. Md. Rifat Hazari et al.

Brief Description:

Conventionally, horizontal axis wind turbine (HAWT) suffers from aerodynamic incompetence in the blade root zone (adjacent the hub) due to numerous non-aerodynamic limitations. Aerodynamic interactions between turbines in a wind farm (WF) also lead to significant loss of WF efficiency. To solve this issue, in this paper, a dual rotor wind turbine (DRWT) based permanent magnet synchronous generator (PMSG) is designed in order to increase the efficiency of the WF. The DRWT consists of two sets of rotors, i.e. primary and secondary rotors. The proposed DRWT mechanism can extract more mechanical energy compared to HAWT. The overall design can be work properly during low wind speed conditions. The whole system including a detailed PMSG model is developed and analyzed in the PSCAD/EMTDC software environment. Actual wind speed data is employed to the wind turbine. Comparison studies are performed with the traditional HAWT in order to reveal the ability of the proposed DRWT based PMSG system. The simulation study shows the proficiency of the proposed DRWT based PMSG system over the traditional HAWT based PMSG system.

Source: https://ieeexplore.ieee.org/document/9331134

Design and Performance Analysis of a PV Control Scheme to Improve LVRT of Hybrid Power System

Author: Dr. Md. Rifat Hazari et al.

Brief Description:

Solar power stations worldwide have been rising every year as well as the usage of sustainable power has increased. The addition into the traditional electricity grid networks of renewable sources such as the photovoltaic (PV) system is an essential challenge, given its erratic power generation. The major issue is to detach PV from the faulty grid, which leads to fluctuation in the system's interconnected PV system and system-wide energy interruptions. The low voltage ride through (LVRT) enables the PV scheme should stay linked to the grid even under fault situations in short periods and must assist the grid return to regular situations according to the modern grid codes. Hence, this paper develops and analyzes five aspects of control strategy to increase PV station's LVRT capability. The in-depth simulation of the independent units of the grid-connected large-scale PV farm is accomplished using PSCAD/EMTDC to assess the feasibility of the suggested control tactic for the modified IEEE nine-bus system.

Source: https://ajse.aiub.edu/index.php/ajse/article/view/127

LVRT and Stability Enhancement of Grid-Tied Wind Farm Using DFIG-Based Wind Turbine

Author: Dr. Md. Rifat Hazari et al.

Brief Description:

According to the grid code specifications, low voltage ride-through (LVRT) is one of the key factors for grid-tied wind farms (WFs). Since fixed-speed wind turbines with squirrel cage induction generators (FSWT-SCIGs) require an adequate quantity of reactive power throughout the transient period, conventional WF consisting of SCIG do not typically have LVRT capabilities that may cause instability in the power system. However, variable-speed wind turbines with doubly fed induction generators (VSWT-DFIGs) have an adequate amount of LVRT enhancement competency, and the active and reactive power transmitted to the grid can also be controlled. Moreover, DFIG is quite expensive because of its partial rating (AC/DC/AC) converter than SCIG. Accordingly, combined installation of both WFs could be an effective solution. Hence, this paper illustrated a new rotor-side converter (RSC) control scheme, which played a significant role in ensuring the LVRT aptitude for a wide range of hybrid WF consisting of both FSWT-SCIGs and VSWT-DFIGs. What is more, the proposed RSC controller of DFIG was configured to deliver an ample quantity of reactive power to the SCIG during the fault state to make the overall system

stable. Simulation analyses were performed for both proposed and traditional controllers of RSC of the DFIG in the PSCAD/EMTDC environment to observe the proposed controller response. Overall, the presented control scheme could guarantee the LVRT aptitude of large-scale SCIG. View Full-Text

Source: https://www.mdpi.com/2571-5577/4/2/33

Design, Implementation and Analysis of a MAGLEV Wind Turbine

Author: Dr. Md. Rifat Hazari et al.

Brief Description:

Conventionally, horizontal axis wind turbine (HAWT) is used in the wind farm applications to generate electricity. But HAWT is very expensive to install, noisy and inefficient in the conversion of wind to energy. Additionally, it requires large amount to space, high wind speed and also it is dependent upon the direction of wind speed. If direction of the wind is changed then it requires Yaw mechanism which is very expensive. On the other hand, the MAGLEV vertical axis wind turbine (VAWT) addresses these problems and provides a more efficient, versatile and elegant method of producing power from wind. MAGLEV is short for "magnetically levitated", meaning the design incorporates magnets to "float" or suspend system components. Therefore, in this paper, an advanced level vertical wind turbine using MAGLEV mechanism is designed and implemented. In this technology, a VAWT, neodymium magnets, black magnets which are attached with wooden disk. Power is generated with an axial flux generator, which incorporates the use of permanent magnets and a set of coils. This designed MAGLEV wind turbine is independent of wind direction. Also, it can operate under low wind speed condition.

Source: https://ieeexplore.ieee.org/document/9528131

IoT Based Power Monitoring of Solar Panel Incorporating Tracking System

Author: Dr. Md. Rifat Hazari et al.

Brief Description:

Solar power added a significant value in energy harvesting in developing country like Bangladesh. People use solar power for homemade electrical appliances, vehicles, satellites and industries etc. The sun position and dust may affect the output of solar panel. Therefore, this paper designed an internet of thing (IoT) based smart system which can rotate the panel to enable

tracking characteristics, cleaning and monitoring of the output. The overall IoT system is employed Arduino Uno, Wi-fi module and mobile phone to get necessary information in the application. Designed system has been verified through both simulation and hardware analysis to validate the work.

Source: https://ieeexplore.ieee.org/document/9528207

Virtual Synchronous Generator Control of Stand-Alone PV Station to Enhance Voltage Stability

Author: Dr. Md. Rifat Hazari et al.

Brief Description:

With the increasing integration of renewable energy resources (RESs) like photovoltaic (PV) systems to the rural consumer may affect the voltage stability during network disturbance situations. This is due to the fact that the conventional inverter system of the PV station cannot inject sufficient reactive power at a transient state. Therefore, to solve this issue, this paper proposes a virtual synchronous generator (VSG) control mechanism of the PV system to enhance voltage stability. The proposed VSG emulates the behavior of conventional power plants and control the reactive power more effectively during the network disturbance event. To justify the validity of the proposed VSG control PV system, simulation analysis, and comparison study has been done with the conventional control mechanism of the PV system.

Source: https://ieeexplore.ieee.org/document/9550928

Primary frequency control of large-scale PV-connected multi-machine power system using battery energy storage system

Author: Dr. Md. Rifat Hazari et al.

Brief Description:

Large-scale grid-tied photovoltaic (PV) station are increasing rapidly. However, this large penetration of PV system creates frequency fluctuation in the grid due to the intermittency of solar irradiance. Therefore, in this paper, a robust droop control mechanism of the battery energy storage system (BESS) is developed in order to damp the frequency fluctuation of the multi-machine grid system due to variable active power injected from the PV panel. The proposed droop control strategy incorporates frequency error signal and dead-band for effective minimization of frequency fluctuation. The BESS system is used to consume/inject an effective

amount of active power based upon the frequency oscillation of the grid system. The simulation analysis is carried out using PSCAD/EMTDC software to prove the effectiveness of the proposed droop control-based BESS system. The simulation result implies that the proposed scheme can efficiently curtail the frequency oscillation.

Source: https://ijpeds.iaescore.com/index.php/IJPEDS/article/view/21459

Voltage stability augmentation of hybrid power system using robust reactive power control strategy of PV plant

Author: Dr. Md. Rifat Hazari et al.

Brief Description:

The involvement of large-scale grid-tied photovoltaic (PV) systems is growing speedily, and enormous effort is given to design the robust control mechanism of PV systems to augment the performance of the PV system in both transient and steady-state states. The terminal voltage may fluctuate at steady-state conditions due to the alternating nature of solar irradiance and affect the LVRT aptitude at the transient period. Therefore, in this paper, a cascaded grid-side AC-DC inverter control strategy is developed by modifying the inverter input signal to control the terminal voltage. The proposed dead-band-based inverter controller maintains the terminal voltage at rated value during steady-state and augments LVRT aptitude at transient conditions by injecting an efficient quantity of reactive power. The overall scenario, including PV system, conventional power plant, and load, has been designed and examined using the "PSCAD/EMTDC" platform. The traditional control system is taken into comparison with the proposed control system to verify the effectiveness of this innovative control technique.

Source: https://www.ijrer.org/ijrer/index.php/ijrer/article/view/12245

Transient Stability Enhancement of a Grid-Connected Large-Scale PV System Using Fuzzy Logic Controller

Author: Dr. Md. Rifat Hazari et al.

Brief DThis paper presents a new intelligent control strategy to augment the low-voltage ride-through (LVRT) potential of photovoltaic (PV) plants, and the transient stability of a complete grid system. Modern grid codes demand that a PV plant should be connected to the main power system during network disturbance, providing voltage support. Therefore, in this paper, a novel fuzzy logic controller (FLC) using the controlled cascaded strategy is proposed for the grid side converter (GSC) of a PV plant to guarantee voltage recovery. The proposed FLC offers variable gains based upon the system requirements, which can inject a useful amount of reactive power

after a severe network disturbance. Therefore, the terminal voltage dip will be low, restoring its pre-fault value and resuming its operation quickly. To make it realistic, the PV system is linked to the well-known IEEE nine bus system. Comparative analysis is shown—using power system computer-aided design/electromagnetic transients including DC (PSCAD/EMTDC) software—between the conventional proportional–integral (PI) controller-based cascaded strategy and the proposed control strategy to authenticate the usefulness of the proposed strategy. The comparative simulation results indicate that the transient stability and the LVRT capability of a grid-tied PV system can be augmented against severe fault using the proposed FLC-based cascaded GSC controller.

Source: https://www.mdpi.com/2079-9292/10/19/2437

Effect of plan layout on electricity consumption to maintain thermal comfort in apartments of Dhaka

Author: Saiful Hasan Tariq et al.

Brief Description:

This paper reports on a study of electricity consumption, for achieving thermal comfort, and possible relation to respective plan layouts, in apartments of tropical Dhaka, the capital of Bangladesh, which is one of the most densely populated cities in the world. As approximately 45% of the total population of Dhaka constitutes the middle income and upper-middle income groups, electricity consumption by this group is a critical factor in the national energy balance. According to recent reports, the electricity consumption in the residential sector has almost doubled in 6 years. During the warm months (March–October), ventilation and air movement are vital for thermal comfort in the tropics, and electrical cooling appliances are commonly used for the purpose. The target middle income group resides in apartments of floor area between 93 and 149 m2 (1000–1600 ft2). A field survey was conducted, whereby scaled drawings of plan layout of the apartments were obtained, to understand the spatial arrangement of the existing apartments, i.e., to assess the arrangement of spaces in the apartment units in terms of their potential to allow air movement. Two basic types of layouts were found mostly used in Dhaka; defined in the study as “open type” and “cellular type” layouts. A questionnaire survey was conducted on sample units, to determine the specifications of electrical appliances being used for cooling and to assess the comfort situation of the inhabitants. It was the contention of this study that there could be a critical analysis of plan layouts in mid-rise apartment buildings, to determine whether there is a relationship between the energy consumption and layout of these plans. Analysis of the findings from the survey and the questionnaire responses reveal that plan layout does, indeed, have a significant impact on electricity consumption needed for thermal comfort.

Source: https://doi.org/10.1007/s12053-020-09875-3

Primary frequency control of large-scale PV-connected multi-machine power system using battery energy storage system

Author: S. M. Imrat Rahman et al.

Brief Description:

Large-scale grid-tied photovoltaic (PV) station are increasing rapidly. However, this large penetration of PV system creates frequency fluctuation in the grid due to the intermittency of solar irradiance. Therefore, in this paper, a robust droop control mechanism of the battery energy storage system (BESS) is developed in order to damp the frequency fluctuation of the multi-machine grid system due to variable active power injected from the PV panel. The proposed droop control strategy incorporates frequency error signal and dead-band for effective minimization of frequency fluctuation. The BESS system is used to consume/inject an effective amount of active power based upon the frequency oscillation of the grid system. The simulation analysis is carried out using PSCAD/EMTDC software to prove the effectiveness of the proposed droop control-based BESS system. The simulation result implies that the proposed scheme can efficiently curtail the frequency oscillation.

Source: http://doi.org/10.11591/ijpeds.v12.i3.pp1862-1871

Development of a Solar Powered Electric Vehicle based on Tadpole Design

Author: S. M. Imrat Rahman et al.

Brief Description:

In this research paper, a simulation-based design of a solar powered 3-wheel tadpole vehicle has been presented. The design focuses on the motor control circuit and the battery charging circuit in addition to the suspension system of the vehicle. Moreover, development of a data logging system for analyzing the performance of this vehicle has been presented in this work. The proposed design can be applied to investigate the performance of solar powered tadpole vehicles.

Source: https://doi.org/10.1109/ICREST51555.2021.9331052

Design and Implementation of Parabolic Trough Solar Thermal Collector

Author: S. M. Imrat Rahman et al.

Brief Description:

The goal of this research paper is to design a parabolic trough solar collector that uses a steam engine for generating power through converged sunlight heat. The most effective shape for a

solar collector is the parabolic trough shape because of its ability to focus sun's energy on a small focal point. The parabolic solar system uses concentrated solar power which uses mirrors and tracking systems to concentrate sunlight into a small area which generates sufficient thermal heat. This heat is utilized for generation of steam and the steam is used for operating a steam engine for producing electricity. A copper tube covered by a black layer is designed which utilizes heat transfer fluid (HTF) inside the metallic tube for producing steam. After producing electricity, the excess steam is utilized for generating safe drinking water. The developed model required very low collector surface area and the production cost is low.

Source: https://doi.org/10.1109/TENSYMP50017.2020.9230854

Modeling and Performance Analysis of an Γ-Model Based DFIG Wind Turbine with Duel Crowbar Protection

Author: S. M. Imrat Rahman et al.

Brief Description:

This paper presents a detailed mathematical model of a doubly fed induction generator (DFIG) based wind turbine system. The controllers associated with this DFIG model are also derived in synchronously rotating reference frame considering Γ-Model of induction generator. A PSCAD/EMTDC simulation model has been implemented based on the proposed DFIG model. The effectiveness of this model is further verified through different case studies where the dynamic response of the implemented PSCAD model is compared with the theoretical model response. The simulation results show satisfactory performance of the proposed model and can be used for evaluation of transient stability of DFIG wind turbine system.

Source: https://doi.org/10.1109/ICASERT.2019.8934482

Stabilization Control of Power System with Large-Scale Wind Farm by Using DFIG Considering Grid Codes

Author: Dr. Effat Jahan et al.

Brief Description:

This paper proposes an innovative operational scheme for a grid-connected large-scale wind farm (WF) which is composed of both fixed speed wind turbines with squirrel cage induction generators (FSWT-SCIGs) and variable speed wind turbine with doubly fed induction generators (VSWT-DFIGs). Normally, SCIG cannot fulfil the necessities of fault ride-through (FRT), because of the insufficient amount of reactive power supply during transient condition which may leads to the instability of the power system. Thus, in this paper, a new technique is proposed to stabilize SCIG by using DFIG in a grid-connected WF. A novel fuzzy logic controller (FLC) based rotor side

controller is proposed for VSWT-DFIG to improve the FRT capability of FSWT-SCIG-based WF and transient stability of entire power system. The proposed FLC is designed in order to inject effective amount of reactive power during fault condition. The effectiveness of the proposed control strategy is verified through simulation analyses on a multi-machine power system model in PSCAD/EMTDC software. Additionally, the transient stability of the entire power system is evaluated by using the transient stability index.

Source: https://ieeexplore.ieee.org/document/8644524

Damping of Frequency Fluctuations of Hybrid Power System by Variable Deloaded Operation of PMSG Based Offshore Wind Farm

Author: Dr. Effat Jahan et al.

Brief Description:

This paper focuses on a novel variable deloaded operation of variable speed wind turbines with permanent magnet synchronous generators (VSWT-PMSGs) based offshore wind farm (OWF) to maintain primary reserve, which is connected to onshore grid through voltage source converter based high voltage DC (VSC-HVDC) transmission system. A centralized droop controller with dead band is designed for VSWT-PMSGs to utilize this reserve power to suppress the frequency fluctuations of the onshore grid due to the installations of large-scale fixed speed wind turbines with squirrel cage induction generators (FSWT-SCIGs) based wind farm (WF) and photovoltaic (PV) power station. The combination of variable deloaded operation and centralized droop controller can give better frequency regulation and decrease energy loss due to the deloaded operation. The effectiveness of the proposed variable deloaded operation and centralized droop controller is verified through simulation analyses on a modified IEEE nine-bus test system. The simulation results reveal that the variable deloaded operation can decrease the energy loss compared to the fixed deloaded operation as well as suppress the frequency fluctuations in the same level as the fixed deloaded operation.

Source: https://www.jstage.jst.go.jp/article/ieejpes/139/4/139_259/_article/-char/en

Primary Frequency Regulation of the Hybrid Power System by Deloaded PMSG-based Offshore Wind Farm using Centralised Droop Controller

Author: Dr. Effat Jahan et al.

Brief Description:

This paper proposes a coordinated frequency control method for variable speed wind turbines with permanent magnet synchronous generators (VSWT-PMSGs) based offshore wind farm (OWF), which is connected to the main onshore grid through voltage source converter (VSC)

based high voltage DC (HVDC) transmission system. The purpose of the proposed system is to damp the frequency oscillations of the onshore grid due to the installation of large-scale fixed speed wind turbines with squirrel cage induction generators (FSWT-SCIGs) based wind farm (WF) and photovoltaic (PV) power station. A novel centralised droop controller with the dead band is designed for VSWT-PMSGs to decrease the frequency fluctuations of the onshore main power system. In the proposed system, primary frequency reserve is implemented by deloading operation of VSWT-PMSGs in the OWF. The effectiveness of the proposed centralised frequency controller is verified through simulation analysis on a modified IEEE nine-bus model system in PSCAD/EMTDC software.

Source: https://digital-library.theiet.org/content/journals/10.1049/joe.2018.9326

Coordinated Control Scheme of Battery Storage System to Augment LVRT Capability of SCIG-Based Wind Turbines and Frequency Regulation of Hybrid Power System

Author: Dr. Effat Jahan et al.

Brief Description:

Fixed speed wind turbine-squirrel cage induction generator (FSWT-SCIG)-based wind farms (WFs) are increasing significantly. However, FSWT-SCIGs have no low voltage ride-through (LVRT) and frequency control capabilities, which creates a significant problem on power system transient and steady-state stability. This paper presents a new operational strategy to control the voltage and frequency of the entire power system, including large-scale FSWT-SCIG-based WFs, by using a battery storage system (BSS). The proposed cascaded control of the BSS is designed to provide effective quantity of reactive power during transient periods, to augment LVRT capability and real power during steady-state periods in order to damp frequency fluctuations. The cascaded control technique is built on four proportional integral (PI) controllers. The droop control technique is also adopted to ensure frequency control capability. Practical grid code is taken to demonstrate the LVRT capability. To evaluate the validity of the proposed system, simulation studies are executed on a reformed IEEE nine-bus power system with three synchronous generators (SGs) and SCIG-based WF with BSS. Triple-line-to-ground (3LG) and real wind speed data are used to analyze the hybrid power grid's transient and steady-state stability. The simulation results indicate that the proposed system can be an efficient solution to stabilize the power system both in transient and steady-state conditions. View Full-Text

Source: https://www.mdpi.com/2079-9292/9/2/239

A Robust Control Strategy to Improve Low Voltage Ride-Through of a Grid-Connected Photovoltaic System

Author: Dr. Effat Jahan et al.

Brief Description:

In this paper, a robust control approach is developed to enhance the transient stability and low-voltage ride-through (LVRT) competence of a grid-connected large-scale solar photovoltaic (PV) plant. The modern grid codes are demanded that the PV plant should provide dynamic support. The proposed control policy can guarantee the LVRT aptitude in accordance with grid codes and power system transient stability against symmetrical and unsymmetrical faults. Besides, a DC-link protection system, AC–DC converter, and DC– AC converter controllers are developed. To analyse the performance of the proposed strategy under different faults, simulation is performed on a customized IEEE nine-bus system including conventional synchronous generator (SG)-based power plants and a PV plant using PSCAD/EMTDC software. Additionally, a comparative study is shown with the conventional control strategy. The simulation analysis shows that PV plant terminal voltage is recovered 90% of its nominal value within 1.5 s, which implies that the LVRT aptitude and transient stability can be enhanced by integrating the proposed strategy.

Source: https://www.actapress.com/Abstract.aspx?paperId=54132

Analysis of a Hybrid Power System Including Large-Scale Wind Farm

Author: Dr. Effat Jahan et al.

Brief Description:

Integration of large-scale grid-tied wind farm (WF) has been rising since the last decade. Most of the WF are built using squirrel cage induction generator (SCIG). In this paper, an analysis has been done on the hybrid power system model contained of conventional power plants and SCIG. The analysis has been done on different parameters of the grid system, i.e., voltage, active, and reactive power, and frequency. Real wind speed data is applied in this work to make realistic response. Simulation has been conducted using PSCAD/EMTDC software.

Source: https://ieeexplore.ieee.org/document/9331117

Transient Stability Enhancement of a Grid-Connected Large-Scale PV System Using Fuzzy Logic Controller

Author: Dr. Effat Jahan et al.

Brief Description:

This paper presents a new intelligent control strategy to augment the low-voltage ride-through (LVRT) potential of photovoltaic (PV) plants, and the transient stability of a complete grid system. Modern grid codes demand that a PV plant should be connected to the main power system during network disturbance, providing voltage support. Therefore, in this paper, a novel fuzzy logic controller (FLC) using the controlled cascaded strategy is proposed for the grid side converter (GSC) of a PV plant to guarantee voltage recovery. The proposed FLC offers variable gains based upon the system requirements, which can inject a useful amount of reactive power after a severe network disturbance. Therefore, the terminal voltage dip will be low, restoring its pre-fault value and resuming its operation quickly. To make it realistic, the PV system is linked to the well-known IEEE nine bus system. Comparative analysis is shown—using power system computer-aided design/electromagnetic transients including DC (PSCAD/EMTDC) software—between the conventional proportional–integral (PI) controller-based cascaded strategy and the proposed control strategy to authenticate the usefulness of the proposed strategy. The comparative simulation results indicate that the transient stability and the LVRT capability of a grid-tied PV system can be augmented against severe fault using the proposed FLC-based cascaded GSC controller. View Full-Text

Source: https://www.mdpi.com/2079-9292/10/19/2437

Design, Implementation and Analysis of a MAGLEV Wind Turbine

Author: Md. Shahariar Parvez et al.

Brief Description:

Conventionally, horizontal axis wind turbine (HAWT) is used in the wind farm applications to generate electricity. But HAWT is very expensive to install, noisy and inefficient in the conversion of wind to energy. Additionally, it requires large amount to space, high wind speed and also it is dependent upon the direction of wind speed. If direction of the wind is changed then it requires Yaw mechanism which is very expensive. On the other hand, the MAGLEV vertical axis wind turbine (VAWT) addresses these problems and provides a more efficient, versatile and elegant method of producing power from wind. MAGLEV is short for "magnetically levitated", meaning the design incorporates magnets to "float" or suspend system components. Therefore, in this paper, an advanced level vertical wind turbine using MAGLEV mechanism is designed and implemented. In this technology, a VAWT, neodymium magnets, black magnets which are attached with wooden disk. Power is generated with an axial flux generator, which incorporates

the use of permanent magnets and a set of coils. This designed MAGLEV wind turbine is independent of wind direction. Also, it can operate under low wind speed condition.

Source: https://ieeexplore.ieee.org/document/9528131

IoT Based Power Monitoring of Solar Panel Incorporating Tracking System

Author: Md. Shahariar Parvez et al.

Brief Description:

Solar power added a significant value in energy harvesting in developing country like Bangladesh. People use solar power for homemade electrical appliances, vehicles, satellites and industries etc. The sun position and dust may affect the output of solar panel. Therefore, this paper designed an internet of thing (IoT) based smart system which can rotate the panel to enable tracking characteristics, cleaning and monitoring of the output. The overall IoT system is employed Arduino Uno, Wi-fi module and mobile phone to get necessary information in the application. Designed system has been verified through both simulation and hardware analysis to validate the work.

Source: https://ieeexplore.ieee.org/document/9528207

Design, Implementation and Analysis of a MAGLEV Wind Turbine

Author: Abir Ahmed et al.

Brief Description:

Conventionally, horizontal axis wind turbine (HAWT) is used in the wind farm applications to generate electricity. But HAWT is very expensive to install, noisy and inefficient in the conversion of wind to energy. Additionally, it requires large amount to space, high wind speed and also it is dependent upon the direction of wind speed. If direction of the wind is changed then it requires Yaw mechanism which is very expensive. On the other hand, the MAGLEV vertical axis wind turbine (VAWT) addresses these problems and provides a more efficient, versatile and elegant method of producing power from wind. MAGLEV is short for "magnetically levitated", meaning the design incorporates magnets to "float" or suspend system components. Therefore, in this paper, an advanced level vertical wind turbine using MAGLEV mechanism is designed and implemented. In this technology, a VAWT, neodymium magnets, black magnets which are attached with wooden disk. Power is generated with an axial flux generator, which incorporates the use of permanent magnets and a set of coils. This designed MAGLEV wind turbine is independent of wind direction. Also, it can operate under low wind speed condition.

Source: https://ieeexplore.ieee.org/document/9528131

Solar Photovoltaic-Based Smart Metering System

Author: Abir Ahmed et al.

Brief Description:

In the modern era demand for energy is growing gradually, but the sources are limited to provide that much energy. To convince the increasing demand for energy, new sources are needed to be found and take the renewable energy in the count as source and allocate the efficiently. This paper aims to reduce the usage of grid electricity by proposing a solar photovoltaic (PV)-based smart metering system. The system consists of solar dc power which can be converted into ac power by using grid inverter. Both grid and solar supply information will be given to the microcontroller and supply will be selected automatically according to the requirement of the appliances. Finally, voltage, current and power consumption parameters will be displayed on an LCD monitor and controlled using GSM module.

Source: https://ieeexplore.ieee.org/document/9331098

Primary frequency control of large-scale PV-connected multimachine power system using battery energy storage system

Author: Dr. Md. Kamrul Hassan et al.

Brief Description:

Large-scale grid-tied photovoltaic (PV) station are increasing rapidly. However, this large penetration of PV system creates frequency fluctuation in the grid due to the intermittency of solar irradiance. Therefore, in this paper, a robust droop control mechanism of the battery energy storage system (BESS) is developed in order to damp the frequency fluctuation of the multi-machine grid system due to variable active power injected from the PV panel. The proposed droop control strategy incorporates frequency error signal and dead-band for effective minimization of frequency fluctuation. The BESS system is used to consume/inject an effective amount of active power based upon the frequency oscillation of the grid system. The simulation analysis is carried out using PSCAD/EMTDC software to prove the effectiveness of the proposed droop control-based BESS system. The simulation result implies that the proposed scheme can efficiently curtail the frequency oscillation.

Source: https://ijpeds.iaescore.com/index.php/IJPEDS/article/view/21459/13527

Designing Grid Connected 1.124 MW Photo-Voltaic System for Kuakata Coastal Area

Author: Dr. Md. Kamrul Hassan et al.

Brief Description:

The paper presents the grid connected photovoltaic power generation system to meet the electricity demand through the renewable solar energy for the Kuakata coastal area in Bangladesh. Grid connected photo-voltaic (PV) systems are gaining traction as a viable alternative

to traditional fossil-fuel generating. Power converter design and operation, as well as how to attain high efficiency for various power combinations, are important considerations in grid-connected PV systems. The MATLAB/Simulink framework was used to create a simulation model for 1.124 MW grid connected 2 Stage 3 Phase solar inverter with transformer, which is given in this article. The coastal area's energy demand will be fulfilled by the solar energy which has been shown in the Homer pro. For modelling 1.124 MW solar power plant 5-acres of land is needed. With a view save the land area, sea bed near the Kuakata sea beach will be utilized for the installation of solar panels. By this way, it can capable to fulfil the energy demand of Kuakata sea beach and surplus energy will go to the national grid. Under various parameter values, MATLAB simulation was used to determine the maximum power output from solar panel. Homer pro was utilized for estimating demand and cost of energy to fulfill the demand of that area and the surplus energy will provide to the grid.

Source: https://ieeexplore.ieee.org/document/9544646

Design and Simulation of Discrete Time Multi-Input Multi-Output Optimal Controller to Control Active and Reactive Power of DFIG

Author: Mohammad Zohurul Islam et al.

Brief Description:

The control of active and reactive power of doubly-fed induction generator (DFIG) in a large scale wind farm has become an important issue for the improvement of wind energy system to provide efficient and reliable electrical power with safety. The control strategies of active power and reactive power can be classified in two types—direct power control and indirect power control. First control strategy has designed based on the chosen switching patterns of inverter depending on the error of active power and reactive power with variable switching frequency. The generated ripple of power is high in this case due to the variable switching frequency. Former control strategy has been designed based on the mathematical model of DFIG. In this case the switching frequency can be kept constant. The active power and reactive power controller has been designed based on the PI controller which can be implemented easily by choosing the gains by trial and error method. But, the overshoot and steady-state error cannot be minimized and the controller is not robust under the variation where the gain of PI controller is chosen by trial and error method. In this paper, a discretetime multi-input and multi-output (MIMO) optimal controller has been designed to control the active and reactive power of DFIG. Moreover, the designed controller is robust under the variation of parameter. The efficacy of the proposed control system has been verified by simulation work which has been done in MATLAB/Simulink software.

Source:
https://drive.google.com/file/d/0Bzp01lYakGlJVnFCU0IzRWRBRmpQZmczaGo1WW1lODhoX3dF/view?usp=sharing&resourcekey=0-QkD7uWDIyRrvm9M3PFnktw

Modeling and Performance Analysis of an Γ-Model Based DFIG Wind Turbine with Duel Crowbar Protection

Author: Mehedi Azad Shawon et al.

Brief Description:

This paper presents a detailed mathematical model of a doubly fed induction generator (DFIG) based wind turbine system. The controllers associated with this DFIG model are also derived in synchronously rotating reference frame considering Γ-Model of induction generator. A PSCAD/EMTDC simulation model has been implemented based on the proposed DFIG model. The effectiveness of this model is further verified through different case studies where the dynamic response of the implemented PSCAD model is compared with the theoretical model response. The simulation results show satisfactory performance of the proposed model and can be used for evaluation of transient stability of DFIG wind turbine system.

Source: https://doi.org/10.1109/ICASERT.2019.8934482

Smart Dual Axis Sun Tracking System for Concentrated Solar Dish using Linear Actuator

Author: Shuvra Saha et al.

Brief Description:

In recent times, electricity generation using solar thermal or concentrated solar power (CSP) is evolving towards large scale electricity production through more efficient conversion systems and cheaper components with longer life. As compared to renewable electricity from wind turbines and solar photovoltaic (PV), CSP plants have the advantage of being able to integrate thermal energy storage or hybridization to supply electricity around the clock, regardless of variations in solar radiation. The collector or reflector system consists of a parabolic dish that concentrates the Sun's rays to a receiver placed at the focal point; this receiver converts the solar energy into electricity using Stirling engine. Accurate sun tracking requires dual axis tracking which involve azimuth and tilt angle optimization. This can be easily achieved using linear actuators. The objective of this project work is to design, model and test a dual axis mirror controller for solar thermal systems that will ensure maximum utilization of Sun rays throughout the day time. The CSP reflector or mirror is controlled using microcontroller (Arduino). Light sensors (LDR) are used to detect the intensity of the Sun rays, and the CSP will be oriented accordingly using two linear actuators with minimum vibration. The linear actuators are controlled using Arduino. Based on the Sun ray's direction and intensity, the required position of the CSP is calculated in terms of azimuth and tilt angles. Accordingly, the CSP is moved using two linear actuators one for azimuth and another for tilt. The maximum weight capacity is approx. 100kg without vibration.

Source: http://fse.green.edu.bd/sti-2019/

Concentrated Solar Power Dish Stirling Technology in Prospect of Energy Crisis in Bangladesh

Author: Shuvra Saha et al.

Brief Description:

With the exponential increase in demand of power all over the world, the limited natural fuel resources are being stressed every hour. No matter the abundance, these resources are bound to deplete completely in far future. Humankind is now moving onto such methods for electricity generation which can meet our demand and preserve the nature's reserves simultaneously. Concentrated Solar Power (CSP) uses the heat from the Sun to produce mechanical thus electrical power. We chose a preexisting method (Euro Dish) and modified it to a level suitable for small-scale/personal use. Some components were unavailable in the country so those were needed to be imported which increased the cost of the project. This is an obstacle in the way of making this technology and method popular and usable on a mass scale, let alone on a personal scale. Due to manual construction of the parabolic concentrator dish (Euro Dish), the efficiency was not up to the expected level. The primary objective, to generate mechanical power from Stirling engine and converting it into electrical power through a dc generator of low r.p.m., was completed with minor inefficiencies and discrepancies.

Source: https://ieeexplore.ieee.org/document/8644477

EVOCATION AND EXPEDIENT OF AN ASSEMBLE OF ROOFTOP SOLAR PV AND VEHICLE TO GRID TECHNOLOGY: ON PERSPECTIVE OF BANGLADESH

Author: Abu Hena MD Shatil et al.

Brief Description:

Demand response systems have become a big draw for reducing peak demand in the electrical power sector as a smart grid enabler. The household consumer will add significantly to the capacity for peak-hour energy demand mitigation. The aim of this paper is to discuss the energy usage of a single household with multiple properties, including household appliances, an electric vehicle (EV), and a battery energy storage device (BESS). A rooftop solar photovoltaic (PV) generation system on a small scale is also a component of a smart household. The BESS and PV are used to charge household equipment, and any excess electricity produced can be pumped back into the grid. The optimization problem of intelligent home energy management is formulated as a mixed integer linear programming problem (MILP). The load serving body registers the energy user for real-time price-based demand response programs (LSE). The simulation results demonstrated the LSE's major contribution to achieving usage cost gains and minimizing peak to average ratios. An algorithm has been proposed to reduce the conversion losses. Eventually then, the whole system analyzed by MATLAB software

Source: https://seu.edu.bd/seujeee/downloads/vol_01_issue_02_Jul_2021/SEUJEEE-Vol01Issue02-1.pdf

Impact of EV Charging on Grid Voltage and Effect of Vehicle to Grid (V2G) On Grid Power

Author: Abu Hena MD Shatil et al.

Brief Description:

Recently in many countries, significant amount of electrical power is consuming by electric vehicles (EV). It is one of the most emerging technologies in modern era. Many development countries have already set their goal to zero emission and replacement of fossil fuel vehicles by EVs. There are so many research works have done to improve the EV technology and still many research works are going to upgrade the technology. The updating battery technology has improved the power efficiency, mileage and speed of the EV. Zero emission, clean technology, higher efficiency than gasoline powered vehicles and low cost of electricity compare to fossil fuels (as many renewable sources are available to produce electricity) are some advantages of EV to gasoline powered vehicles. But besides those advantages of electric vehicles there are some bad impacts of EV charging on electric grid. Analyzes of those bad impacts of EV charging on distribution grid are highly importance for the development of electric vehicles. To analyze the EV charging impacts on grid voltage and to see the effect of vehicle to grid (V2G) system on grid power, a very simplified EV charging model is used in this paper which is designed by MATLAB/Simulink. In this paper grid voltage and power were analyzed and measured to see the effect of EV charging. Vehicle to grid (V2G) technology is also used to analyze the grid power during V2G on and off and the differences between these two conditions were measured from the simulation and the results were compared.

Source:
http://ecc.journalspub.info/index.php?journal=JEMD&page=article&op=view&path%5B%5D=1073

Smart Grid Prospects and Challenges in Bangladesh; A Distribution System Operator's Viewpoint

Author: Abu Hena MD Shatil et al.

Brief Description:

Distribution Service Operators (DSOs) are critical in the future distribution system's liberalized energy market. Apart from their primary responsibility of supplying electricity to consumers, DSOs, especially in Bangladesh, are being asked to provide infrastructure to enable customer-choice energy retail. To meet this challenge, traditional power generation grids are becoming smarter by integrating new information and communication technology into their service. This results in a higher-quality, quicker, and more efficient service for the customer while also enabling massive two-way data transmission between the consumer and the delivery service provider. This article provides an overview of the present state of affairs for power distribution operators in Bangladesh after the vertical unbundling of the Bangladeshi electricity industry and

the privatization of DSOs. Additionally, the current position of DSOs is clarified, as are the operational technologies (OT) in use and their convergence with information technologies (IT), which constitute the first steps toward a smart grid capable of meeting future challenges.

Source: https://ieeexplore.ieee.org/document/9528129

Design and Implementation of a Synchronous Generator with Rotor Angle Stability Control for Damping Interarea Oscillations of Interconnected Power Systems via PSS

Author: Abu Hena MD Shatil et al.

Brief Description:

The main aim of this paper is to regulate the rotor angle of the synchronous generator and solve the inter-area mode of oscillation in a power system using a power system stabilizer. That is a major concern. The inter-area modes are basically an interaction between the mechanical parts of the generating plans through the electrical part of the system. So, the transmittance of the electrical power of the areas has a significant influence generally on the damping. Inter-area oscillations are innate to power systems. This type of oscillation is characterized by a group of generators in one area of the system oscillating against another group located in another area. In this paper power system stabilizer (PSS) is used to damp the inter-area mode of oscillation in the power system. In this system simulation model is set up into MATLAB/SIMULINK software.

Source: https://ieeexplore.ieee.org/document/9396810

An Unsupervised Protection Scheme for Overhead Transmission Line with Emphasis on Situations During Line and Source Parameter Variation

Author: Abu Hena MD Shatil et al.

Brief Description:

Quick removal of the short circuit faults in a power transmission and distribution system solely depends on an accurate characterization of them. Characterization of short circuit fault demands continuous monitoring of the electrical signals residing with the power transmission lines that change with the operating conditions. Taking the deficiencies as a research challenge, this paper introduces an unsupervised learning framework for fault detection and classification (FDC) based on the capsule neural network. The proposed framework learns from the unlabeled dataset and captures more extra target-oriented attributes. The Gramian angular field (GAF) image representations of the sampled signals are fed as input to the proposed model. The performance of the proposed method is verified in terms of errors due to the source and line parameters variation. Furthermore, to acquire more intuitive insight, a comparison analysis among the existing commensurate methods and the proposed architecture is carried out. The results found from the verification indicates that the proposed method has the ability to provide more than 99% classification accuracy.

Source: https://ieeexplore.ieee.org/document/9331170

Augmentation of Battery Management Systems in Smart-Grid operation using Fuzzy Logic

Author: Abu Hena MD Shatil et al.

Brief Description:

This paper proposes an idea of optimizing battery management system using fuzzy logic for a smart grid system. The involvement of a fuzzy logic controller makes the existing control mechanisms for the battery management system more intelligent hence allowing the system to prioritize between the loads and multiple batteries in the battery storage system (BSS) which enables the utilization of the harnessed solar energy with greater service continuity. This design involves a much more effective algorithm of a load and battery management system using fuzzy sets which allows to optimize solar power utilization and maintaining smooth battery health conditions. Finally, a comparative study is illustrated showing the differences between a system working with a greater number of membership functions (64 rules) and the one working with only two membership functions (8 rules).

Source: https://ieeexplore.ieee.org/document/9331034

Modelling and Analysis of a Microgrid with Diesel Generator and Battery System

Author: Abu Hena MD Shatil et al.

Brief Description:

Now a day electricity is essential for each and every individual. The Population is growing rapidly, and this growth validates an expanding need for energy also in remote areas and islands of Bangladesh. St. Martin's island is also in need of electricity. This system has two loads, one is fixed loads and another is a dump load. Diesel generator load is available all-time in this system. Besides this, the alternate source Battery Energy Storage System (BESS) is used when the diesel generator is not full fill the demand. To meet the demand, a microgrid equivalent model with a battery will an effective solution. It is also using the battery throughput heavily can reduce fuel consumption. In contrast, this microgrid system will be the most feasible and accessible

Source: https://ieeexplore.ieee.org/document/9331110

An Insight into Domestic Power Monitoring

Author: Abu Hena MD Shatil et al.

Brief Description:

A modern digital electric power monitoring system technique is proposed in this paper. Using an Arduino device as a microcontroller, it manages a single-phase electrical circuit to read the voltage and current values from the sensors. The calculated data would then be transmitted via

the Wi-Fi transmitter to an Android application. As a microprocessor, an Arduino Nano is used to measure the results obtained from voltage and current sensors in the design and calculate the electricity, which is then transmitted through SP32 to an Android smartphone app. The Arduino Nano and SP32 are microcontrollers and wireless tools that are affordable. A latest Android application that uses open source Kodular tools to track voltage and current measurements. This facilitates the control of certain characteristics of basic voltage power efficiency.

Source: https://ieeexplore.ieee.org/document/9397925

Analysis of Measured Current Densities and Power Densities Obtained From a Microbial Fuel Cell Using Saltbridge as Membrane

Author: Abu Hena MD Shatil et al.

Brief Description:

This research paper analyzes the performance of Microbial Fuel Cell (MFC) for different sludges (drain sludge, tannery sludge and Turag sludge). Saltbridge was used here as proton exchange membrane whereas starch of boiled rice was utilized as a source of carbohydrates for the growth of the microorganism. Water was placed in the cathode chamber as the electron acceptor. A total number of three experiments were carried out throughout the research and all of them were inspected for seven days under aerobic condition. A fixed amount of sludge (1 L), substrate (1 L) and water (2 L) were used. Analysis of the MFCs constructed during this research work is based on the measured current density and power density from each experiment across different loads. In this study 359.6 mV was measured as the highest voltage across while 13.07 mA/m 2 and 4.7 mW/m 2 were recorded as maximum current density and power density respectively for Turag sludge.

Source: https://ieeexplore.ieee.org/document/8726789

Generating Electricity Using INVELOX and a Better One Compared to Traditional Wind Turbine

Author: Abu Hena MD Shatil et al.

Brief Description:

In order to fulfill the demand of energy, popularity of renewable energy is increasing day by day. Using the renewable technology new path has been created by "Generating Electricity on Roadside Using INVELOX". It is mainly funnel tube wind turbine. The main purpose of this project is to make proper use of the roadside for producing green energy. It is able to capture air which is created by the movement of vehicles and air pass through a narrow space path in the INVELOX. In this path a generator is placed. It converts mechanical energy into electrical energy. Actually,

these types of wind turbine do not consume much more space. On the roadside it is quite difficult to generate electricity because of scattered air. But INVELOX can work properly and generate electricity enormously. The simulation of this project is done using SOLIDWORKS software. In the simulation part the changes of velocity & pressure occurred in the INVELOX is shown. Implemented new generator, collected field data and tried to improve more for the project system configuration

Source: https://ieeexplore.ieee.org/document/8644316

Comparison of Current Density and Power Density Obtained From a Double Chamber Microbial Fuel Cell For Different Sludges

Author: Abu Hena MD Shatil et al.

Brief Description:

This research paper analyzes the performance of Microbial Fuel Cell (MFC) under aerobic condition for drain sludge, tannery sludge and Turag sludge. Starch of boiled rice was applied as source of carbohydrates for the growth of bacteria. Saltbridge was used as the membrane. Water was placed in cathode chamber as electron acceptor. A total number of three experiments were carried out throughout the research and all of them were observed for seven days. A fixed amount of sludge (0.5L), substrate (0.5L) and water (1L) was used. Analysis of the MFCs constructed during this research work is based on the obtained current density and power density from each experiment across different loads. In this study 220.77 mV was measured as highest voltage across while 12.23 mA/m 2 and 2.7 mW/m 2 were recorded as maximum current density and power density respectively for Turag sludge.

Source: https://ieeexplore.ieee.org/document/8644198

Renewable Powered Portable Weather Update Station

Author: Abu Hena MD Shatil et al.

Brief Description:

Weather estimate, in reality continuous weather gauge is essential for our day by day life particularly in agribusiness. National weather data does not generally contain the precise information of each area rather it contains the information of closest climate station for a timeframe. The fundamental aim of this project is to develop a RES powered Weather Station which will help to monitor the weather parameters. Such a project contains sensors for detecting temperature, humidity, raindrop, carbon mono-oxide, smoke, LPG in the environment, barometric pressure, altitude etc. The information from the sensors are gathered by the Arduino. Arduino sends the sensors information in LCD display. Additionally, the device sends an SMS

which contains weather information to the user with the assistance of a GSM module. At the end of the project the results have been compared between the national weather data and the actual reading. According to the results, the percentage of deviation for Temperature is 1%, Humidity is 5% and Barometric Pressure is 8%.

Source: https://ieeexplore.ieee.org/document/8644330

Short-Term Electrical Load Forecasting Via Deep Learning Algorithms to Mitigate the Impact of Covid-19 Pandemic on Power Demand

Author: Kazi Firoz Ahmed et al.

Brief Description:

The COVID-19 situation has created an exceptional challenge in the power management system (PMS). This work mainly focuses on the load management through load forecasting. Power generation and distribution is the most important part of PMS. Accurate load forecasting can help to secure electricity scheduling, supply, and reduce the wastage of power. Right now, social distancing has created a great challenge to the administrators to run the power system efficiently and uninterruptedly with minimum involvement of human. In the sector of load management, it can be done through a proper and faster load forecasting approach. Electrical Load Forecasting through deep learning algorithm can perform an effective role in Power Management System (PMS). In this research real data is collected from West Zone Power Distribution Company Limited (WZPDCL) and meteorological data like temperature and humidity are collected from the website of Bangladesh Meteorological Department to train and forecast electrical load using MATLAB. Long-Short Term Memory (LSTM), Feed Forward Back Propagation (FFBP) and ELMAN Neural Network (NN) are used to forecast electrical load. As exogenous data, the load factor (L.F.), power factor (P.F.), current and temperature were used to train algorithms in forecasting the electrical load. A comparative analysis is shown to indicate which is the best suitable method for load forecasting of WZPDCL. Electrical load forecasting results are evaluated through Root Mean Square Error (RMSE). In this research for short-term electrical load forecasting, Feed Forward Back Propagation has shown a minimum RMSE value.

Source: https://ieeexplore.ieee.org/document/9528182/

A Feasible Solution To Unelectrified Bauphal Area Using PV/Biogas/HFC Hybrid Power System Based on Real Load Data

Author: Kazi Firoz Ahmed et al.

Brief Description:

In making countries, deficiency of power is the principal obstruction for financial and social turn of events. A rising nation like Bangladesh is still in lack of electricity in remote island areas. Those areas could be electrified by diesel generators but because of carbon dioxide emission by diesel fuel, alternative power generation scenarios are needed to consider. This paper suggests a hybrid generation system for such a remote area from Bangladesh where still people are using PV panels to get electricity during daytime. But at night they are deprived from electricity. In this paper the feasibility study is done for renewable resources for that the load data is collected from door-to-door survey process. Simulation was carried in HOMER (Hybrid Optimization Model for Electric Renewables) software. HOMER uses maximum simulation per optimization technique to perform maximum number of possible combinations, system design precision technique to select a precise system, net present cost (NPC) precision technique to get the best NPC and optimization category winners technique to run additional optimizations with or without each component. Bauphal area has 14 Unions, one Paurashava, 135 Mauzas/Mahallas, and 147 villages. Total population is near about 1500. The hybrid system considered is composed of PV, Biogas generator and Hydrogen Fuel Cell (HFC). Because of the availability of biomass, the biogas generator is considered. Result showed the hybrid system comprises 48% of PV penetration, 2% HFC and 50% of biogas generator with Cost of Electricity (COE)

Source: https://ieeexplore.ieee.org/document/9528284/

Concentrated Solar Power Dish Stirling Technology in Prospect of Energy Crisis in Bangladesh

Author: Kazi Firoz Ahmed et al.

Brief Description:

With the exponential increase in demand of power all over the world, the limited natural fuel resources are being stressed every hour. No matter the abundance, these resources are bound to deplete completely in far future. Humankind is now moving onto such methods for electricity generation which can meet our demand and preserve the nature's reserves simultaneously. Concentrated Solar Power (CSP) uses the heat from the Sun to produce mechanical thus electrical power. It was chosen a preexisting method (Euro Dish) and modified it to a level suitable for small-scale/personal use. This is an obstacle in the way of making this technology and method popular and usable on a mass scale, let alone on a personal scale. In this paper, stirling engine was used as a heat engine with concentrated solar power. It also shows the comparison between concentrated solar power (CSP) and photovoltaic (PV) system. The primary objective, to generate mechanical power from Stirling engine and converting it into electrical power through a dc generator of low r.p.m., was completed with minor inefficiencies and discrepancies.

Source: https://ieeexplore.ieee.org/document/8644477/

A Comparative Performance Analysis between Serpentine-Flow Solar Water Heater and Photovoltaic Thermal Collector under Malaysian Climate Conditions

Author: Dr. Afroza Nahar et al.

Brief Description:

Solar energy has increasingly been employed for domestic and industrial water heating. Both conventional solar water heater (SWH) and photovoltaic thermal (PVT) systems suffer from the drawback of poor energy conversion efficiency. In this article, a unique parallel serpentine-flow thermal collector has been designed and developed that has been employed as an isolated SWH and also integrated with a 32-cell monocrystalline photovoltaic (PV) module. Simulation models of both SWH and PVT systems have been built in TRNSYS to study their thermal performance numerically. Thereafter, outdoor experimental investigations have been conducted under the composite climates of Malaysia. Experimental results show very good agreement with the simulation outcomes with disparity less than 2%. At the optimum flow rate, the maximum thermal efficiencies of SWH and PVT are 82.5% and 74.62%, respectively. Superior water outlet temperature was obtained with SWH. Although SWH exhibits superior thermal performance, PVT's additional electrical output might make it preferable for several applications.

Numerical investigation on the effect of different parameters in enhancing heat transfer performance of photovoltaic thermal systems

Author: Dr. Afroza Nahar et al.

Brief Description:

Photovoltaic thermal (PV/T) collectors that supply both electricity and heat are growingly becoming popular in household and other applications. However, efficient heat removal from backside of PV module is still a challenge that hampers its electrical as well as thermal performance. In the present research, an absorber-plate less thermal collector has been introduced and mathematical model of such a PV/T system has been developed, which is employed in COMSOL Multiphysics® software to simulate the heat transfer phenomenon in the system. Effect of different flow parameters on heat transfer and PV/T performance is thus studied numerically in the developed simulation model. Also, the effect of irradiation level and depth of the flow channel has been examined on the thermal as well as electrical performance of the module. Results reveal that PV/T electrical and thermal efficiency increase with both of Reynolds and Prandtl number. Heat transfer rate is observed to increase as high as 25.5% with increasing Reynolds number. A maximum reduction in cell temperature of 10.2 _C is obtained by increasing the channel depth. Elimination of absorber plate from thermal collector simplified the design reducing its weight and cost as well.

Effect of Nanofluid Properties and Mass-Flow Rate on Heat Transfer of Parabolic-Trough Concentrating Solar System.

Author: Dr. Afroza Nahar et al.

Brief Description:

Sustainable power generation, energy security, and global warming are the big challenges to the world today. These issues may be addressed through the increased usage of renewable energy resources and concentrated solar energy can play a vital role in this regard. The performance of a parabolic-trough collector's receiver is here investigated analytically and experimentally using water based and therminol-VP1based CuO, ZnO, Al2O3, TiO2, Cu, Al, and SiC nanofluids. The receiver size has been optimized by a simulation program written in MATLAB. Thus, numerical results have been validated by experimental outcomes under same conditions using the same nanofluids. Increased volumetric concentrations of nanoparticle is found to enhance heat transfer, with heat transfer coefficient the maximum in W-Cu and VP1-SiC, the minimum in W-TiO2 and VP1-ZnO at 0.8 kg/s flow rate. Changing the mass flow rate also affects heat transfer coefficient. It has been observed that heat transfer coefficient reaches its maximum of 23.30% with SiC-water and 23.51% with VP1-SiC when mass-flow rate is increased in laminar flow. Heat transfer enhancement drops during transitions of flow from laminar to turbulent. The maximum heat transfer enhancements of 9.49% and 10.14% were achieved with Cu-water and VP1-SiC nanofluids during turbulent flow. The heat transfer enhancements of nanofluids seem to remain constant when compared with base fluids during either laminar flow or turbulent flow.

Computational Modeling for photovoltaic thermal system

Author: Dr. Afroza Nahar et al.

Brief Description:

Photovoltaic thermal (PV/T) system is a well-engineered extension of photovoltaic (PV) technology to get both heat and electricity. Heat exchanger (flow channel) extract heat from the PV cells by heat transfer fluid for thermal applications. Material used to fabricate the flow channel has a vital impact on effective heat removal. In the present research, effect of flow channel material on heat transfer rate and PV/T performance has been investigated experimentally for copper and aluminum-based PV/T system under the same ambient condition. Maximum PV/T thermal efficiency attained are 71% and 70% for copper and aluminum channel respectively where the aluminum-based PV/T is about 2.5 times cheaper than copper-based PV/T. It can be concluded that aluminum-based PV/T is more cost-effective.

Effects of the Flow Channel Materials on the Performance of the Photovoltaic Thermal System.

Author: Dr. Afroza Nahar et al.

Brief Description:

Photovoltaic thermal (PV/T) system is a well-engineered extension of photovoltaic (PV) technology to get both heat and electricity. Heat exchanger (flow channel) extract heat from the PV cells by heat transfer fluid for thermal applications. Material used to fabricate the flow channel has a vital impact on effective heat removal. In the present research, effect of flow channel material on heat transfer rate and PV/T performance has been investigated experimentally for copper and aluminum-based PV/T system under the same ambient condition. Maximum PV/T thermal efficiency attained are 71% and 70% for copper and aluminum channel respectively where the aluminum-based PV/T is about 2.5 times cheaper than copper-based PV/T. It can be concluded that aluminum-based PV/T is more cost-effective.

Performance Analysis of Multi-Input DC-DC Boost Converter for Hybrid Power System.

Author: Susmita Ghosh et al.

Brief Description:

This paper demonstrates a multiple input DC-DC boost converter for hybrid renewable energy system. The hybrid topology operates receiving power from renewable energy sources of PV cell and wind turbine. The converter has been simulated using PROTEUS 8. Based on simulation hardware system has been designed and operated for DC sources. After successful operation of the converter, same design has used for renewable energy sources (PV cell and wind turbine) and it reveals the effectiveness of converter by obtaining increased voltage level with almost zero ripples.

Link: https://ieeexplore.ieee.org/document/8959517

Damping of Frequency Fluctuations of Hybrid Power System by Variable Deloaded Operation of PMSG Based Offshore Wind Farm

Author: Prof. Dr. Mohammad Abdul Mannan et al.

Brief Description:

This paper focuses on a novel variable deloaded operation of variable speed wind turbines with permanent magnet synchronous generators (VSWT-PMSGs) based offshore wind farm (OWF) to maintain primary reserve, which is connected to onshore grid through voltage source converter based high voltage DC (VSC-HVDC) transmission system. A centralized droop controller with dead

band is designed for VSWT-PMSGs to utilize this reserve power to suppress the frequency fluctuations of the onshore grid due to the installations of large-scale fixed speed wind turbines with squirrel cage induction generators (FSWT-SCIGs) based wind farm (WF) and photovoltaic (PV) power station. The combination of variable deloaded operation and centralized droop controller can give better frequency regulation and decrease energy loss due to the deloaded operation. The effectiveness of the proposed variable deloaded operation and centralized droop controller is verified through simulation analyses on a modified IEEE nine-bus test system. The simulation results reveal that the variable deloaded operation can decrease the energy loss compared to the fixed deloaded operation as well as suppress the frequency fluctuations in the same level as the fixed deloaded operation.

Source: https://www.jstage.jst.go.jp/article/ieejpes/139/4/139_259/_article/-char/en

Coordinated Control Scheme of Battery Storage System to Augment LVRT Capability of SCIG-Based Wind Turbines and Frequency Regulation of Hybrid Power System

Author: Prof. Dr. Mohammad Abdul Mannan et al.

Brief Description:

Fixed speed wind turbine-squirrel cage induction generator (FSWT-SCIG)-based wind farms (WFs) are increasing significantly. However, FSWT-SCIGs have no low voltage ride-through (LVRT) and frequency control capabilities, which creates a significant problem on power system transient and steady-state stability. This paper presents a new operational strategy to control the voltage and frequency of the entire power system, including large-scale FSWT-SCIG-based WFs, by using a battery storage system (BSS). The proposed cascaded control of the BSS is designed to provide effective quantity of reactive power during transient periods, to augment LVRT capability and real power during steady-state periods in order to damp frequency fluctuations. The cascaded control technique is built on four proportional integral (PI) controllers. The droop control technique is also adopted to ensure frequency control capability. Practical grid code is taken to demonstrate the LVRT capability. To evaluate the validity of the proposed system, simulation studies are executed on a reformed IEEE nine-bus power system with three synchronous generators (SGs) and SCIG-based WF with BSS. Triple-line-to-ground (3LG) and real wind speed data are used to analyze the hybrid power grid's transient and steady-state stability. The simulation results indicate that the proposed system can be an efficient solution to stabilize the power system both in transient and steady-state conditions.

Source: https://www.mdpi.com/2079-9292/9/2/239

A Robust Control Strategy to Improve Low Voltage Ride-Through of a Grid-Connected Photovoltaic System

Author: Prof. Dr. Mohammad Abdul Mannan et al.

Brief Description:

In this paper, a robust control approach is developed to enhance the transient stability and low-voltage ride-through (LVRT) competence of a grid-connected large-scale solar photovoltaic (PV) plant. The modern grid codes are demanded that the PV plant should provide dynamic support. The proposed control policy can guarantee the LVRT aptitude in accordance with grid codes and power system transient stability against symmetrical and unsymmetrical faults. Besides, a DC-link protection system, AC–DC converter, and DC– AC converter controllers are developed. To analyze the performance of the proposed strategy under different faults, simulation is performed on a customized IEEE nine-bus system including conventional synchronous generator (SG)-based power plants and a PV plant using PSCAD/EMTDC software. Additionally, a comparative study is shown with the conventional control strategy. The simulation analysis shows that PV plant terminal voltage is recovered 90% of its nominal value within 1.5 s, which implies that the LVRT aptitude and transient stability can be enhanced by integrating the proposed strategy.

Source:
https://www.researchgate.net/publication/348132767_A_ROBUST_CONTROL_STRATEGY_TO_IMPROVE_LOW_VOLTAGE_RIDE-THROUGH_OF_A_GRID-CONNECTED_PHOTOVOLTAIC_SYSTEM

Primary frequency control of large-scale PV-connected multimachine power system using battery energy storage system

Author: Prof. Dr. Mohammad Abdul Mannan et al.

Brief Description:

Large-scale grid-tied photovoltaic (PV) station are increasing rapidly. However, this large penetration of PV system creates frequency fluctuation in the grid due to the intermittency of solar irradiance. Therefore, in this paper, a robust droop control mechanism of the battery energy storage system (BESS) is developed in order to damp the frequency fluctuation of the multi-machine grid system due to variable active power injected from the PV panel. The proposed droop control strategy incorporates frequency error signal and dead-band for effective minimization of frequency fluctuation. The BESS system is used to consume/inject an effective amount of active power based upon the frequency oscillation of the grid system. The simulation analysis is carried out using PSCAD/EMTDC software to prove the effectiveness of the proposed droop control-based BESS system. The simulation result implies that the proposed scheme can efficiently curtail the frequency oscillation.

Source: https://ijpeds.iaescore.com/index.php/IJPEDS/article/view/21459

Electrochemical and structural characterization of polyacrylonitrile (PAN)–based gel polymer electrolytes blended with tetrabutylammonium iodide for possible application in dye-sensitized solar cells

Author: Dr. Mohammad Mahbub Rabbani et al.

Brief Description:

Polyacrylonitrile (PAN)–based gel polymer electrolytes (GPEs) consisting of plasticizers ethylene carbonate (EC) and propylene carbonate (PC) and different compositions of tetrabutylammonium iodide (TBAI) salt have been investigated. The GPEs have been characterized by electrochemical impedance spectroscopy (EIS), linear sweep voltammetry (LSV), and X-ray diffraction (XRD) techniques. EIS study shows that the GPE containing 30 wt% TBAI has the lowest bulk impedance, Rb (23 Ω), and highest room temperature ionic conductivity (3.46 × 10−3 S cm−1). Conductivity-temperature relationship in the temperature range studied obeys Arrhenius rule. The Ea value is decreased with TBAI percentage and is the lowest (12.59 kJ/mol) for GPE containing 30 wt% TBAI. From LSV experimental data, the limiting current density (Jlim), apparent diffusion coefficient of triiodide ion (D∗I−3), and exchange current density (J0) have been calculated. The highest value for each of these parameters is 5.00 mA cm−2, 6.59 × 10−7 cm2 s−1, and 0.63 mA cm−2, respectively, for the highest conducting GPE. All samples are amorphous. LSV at stainless steel showed that the electrochemical stability window is 2.2 V. The cyclic voltammetry (CV) was performed from 1 to 1000 cycle which showed good electrochemical stability.

Source: https://link.springer.com/article/10.1007/s11581-020-03612-7