MyHVnet Newsletter

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MyHVnet is the abbreviated name for Malaysian High Voltage Network – a networking group for high voltage engineering in Malaysia.

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Electrifying the Future: An Industry-Academic Knowledge Sharing Session

KAJANG, 1 July 2019 – On Wednesday 26th June 2019, IEEE Dielectrics and Electrical Insulation Society (DEIS) Malaysia Chapter, in collaboration with the Institute of Power Engineering UNITEN and the Malaysian High Voltage Network (MyHVnet) had organised a half-day seminar entitled "Electrifying the Future: An Industry-Academic Knowledge Sharing Session". This programme aimed to gather industry professionals and experts, as well as prominent researchers and academicians in the field of electrical engineering, to discuss the future of the electricity industry.

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Group photo with Ir. Dr. Mohd Fadzil Mohd Siam (middle right) and Professor Paul Lewin (middle left).

Technical Visit to Janamanjung 500 kV Gas Insulated Transmission Line Substation

SERI MANJUNG, 18 April 2019 – On 16th April 2019, IEEE Dielectrics and Electrical Insulation Society (DEIS) Malaysia Chapter, in collaboration with Malaysian High Voltage Network (MyHVnet), had organized an industrial visit to Janamanjung Main Intake Substation, Perak. The main objective of this visit was to learn about the implementation of Malaysia's first and only gas insulated transmission line (GIL) system. The system, which operates at 50Hz 500kV/4000A, was

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Group photo at Janamanjung GIL substation.

MyHVnet Chairman's Remarks

Assoc. Prof. Ir. Dr. Mohamad Kamarol Mohamad Jamil, Universiti Sains Malaysia.

One year has past since I have been the Chairman of MyHVnet. Throughout the year, MyHVnet, in collaboration with IEEE Dielectrics and Electrical Insulation Society (DEIS) Malaysia Chapter, has successfully conducted numerous activities, such as industrial visit to Jana-manjung gas insulated transmission line (GIL) substation, seminars, workshops and technical talks. Such activities may provide networking between industries and higher education institutions, and knowledge of the recent technology development in high voltage related research and applications. Furthermore, MyHVnet and DEIS Malaysia have recently collaborated with UiTM Bukit Mertajam to organise the 2020 PTeC and MyHVnet Colloquium, which will be held on 3rd Feb 2020 at UiTM Bukit Mertajam, Pulau Pinang. We expected that the joint colloquium would provide a platform for researchers from various academic and industrial backgrounds to develop their network and exchange their knowledge, ideas and expertise on a wide range of high voltage engineering research and applications as well as in the field of power systems. We hope that this key event of MyHVnet would be continuously organised in the future and receive full support from MyHVnet members from universities and industries across Malaysia. Perhaps, this event can attract international participations in the future.

There is still one more year left for me to drive MyHVnet, and I hope that MyHVnet can continue to strengthen its presence and be a key platform for high voltage research and development in Malaysia and overseas. With the commitment of MyHVnet committee members, I believe more activities can be conducted in 2020. I would like to take this opportunity to thank all the members of MyHVnet for their tremendous support and effort in making MyHVnet activities a success. Lastly, I wish MyHVnet members all the best and success in your professionalism and look forward to meeting you in next events.

Technical Talk on Protection Devices

Johor Bahru, 10 December 2019 – The IEEE Dielectrics and Electrical Insulation Society (DEIS) Malaysia Chapter technically supported a technical talk on "Protection Devices: Miniature Circuit Breakers and Residual Current Circuit Breakers" organised by the Institute of High Voltage and High Current (IVAT), Universiti Teknologi Malaysia (UTM), on 21 August 2019 at IVAT, UTM Johor Bahru.

During the talk, Mr. Geoffrey Quek, from Hager Engineering (M) Sdn. Bhd., shared his experience on the importance of protection devices and different categories of protection devices. In addition, the principles behind the operation of miniature circuit breakers and residual current circuit breakers were explained to the audience. Appropriate selections of protection devices, especially for residential buildings, were also highlighted. The talk later ended with a question-and-answer session between Mr. Quek and the audience, which allowed the audience to obtain further clarification regarding the topic.

DEIS and IVAT sincerely thank Mr. Quek for his kindness to share his expertise in the field of protection devices and hope to have more events like this in the future.

Ir. Dr. Lau Kwan Yiew, Universiti Teknologi Malaysia.

Mr. Quek (fourth from left) with participants .

About IEEE DEIS Malaysia Chapter

MALAYSIA, 10 December 2019 – The IEEE Dielectrics and Electrical Insulation Society (DEIS) Malaysia Chapter was established in Malaysia in May 2015 with the aims to enhance networking and stimulate research and development in the field of dielectrics and electrical insulation in Malaysia. Its field of interest is in line with that of DEIS, i.e., the study and application of dielectric phenomena and behavior and the development, characterization and application of all gaseous, liquid and solid electrical insulating materials and systems utilized in electrical and electronic equipment. Through committees, IEEE DEIS Malaysia Chapter hopes to promote the close cooperation and exchange of technical information among its members.

Those joining DEIS will have the possibility of networking with a large number of experts worldwide, including Malaysia (through IEEE DEIS Malaysia Chapter), to show the results of their research activity or remain informed in the latest developments in their field. For more information, please visit:

http://deis.ieeemy.org/ (IEEE DEIS Malaysia Chapter)

http://www.ieeedeis.org/ (IEEE DEIS)

News on MyHVnet

In case you missed the previous news on Malaysian High Voltage Network (MyHVnet), Issues 1 to 4 of MyHVnet Newsletter (an initiative for the dissemination of high voltage related news, with particular emphasis on MyHVnet's activities) can be downloaded from the following link:

http://ivat.utm.my/myhvnet/news/


MyHVnet
Newsletter
Technical Visit to HVDC Station
DEIS Distinguished Lecturer Programme: Workshop with Professor Tanaka


MyHVnet
Newsletter
2019 MyHVnet AGM
Committee Meeting of ICPADM 2021

IEEE DEIS Malaysia Chapter

About IEEE DEIS Malaysia Chapter

- The Institute of Electrical and Electronics Engineers (IEEE) Dielectrics and Electrical Insulation Society (DEIS) Malaysia Chapter was established in Malaysia in 2015.
- IEEE DEIS Malaysia Chapter's establishment stems from the need of the dielectrics community in Malaysia to enhance networking and stimulate research and development in the field of dielectrics and electrical insulation.

About DEIS

- DEIS is interested in the study and application of dielectrics from the molecular level, through nano-structured materials, to insulation systems in industrial, commercial, and power system equipment, to emerging applications such as those at high power levels and in biological and other small-scale systems.
- DEIS supports the entire scope of the field from advancing the basic science, to enhancing the ability of practicing engineers to use emerging dielectric materials, to the development of standards for the prudent application of existing and new insulation systems.

Picture courtesy of DEIS

- The field of interest of DEIS shall be the study and application of dielectric phenomena and behavior and the development, characterization and application of all gaseous, liquid and solid electrical insulating materials and systems utilized in electrical and electronic equipment.
- DEIS is also involved in the creation of voluntary engineering standards and the recommended practices related thereto.
- DEIS promotes the close cooperation and exchange of technical information among its members and to this end holds meetings for the presentation of papers and their discussion.
- Through committees DEIS stimulates research, develops appropriate studies and standards, and sponsors periodic and special publications in the field of dielectrics and electrical insulation.

DEIS Membership

- Joining IEEE DEIS will offer you the possibility of networking with a large number of experts to show the results of your research activity or remain informed in the latest developments in your field.
- For more information, please visit:
  http://deis.ieeemy.org/ (IEEE DEIS Malaysia Chapter)
  http://www.ieeedeis.org/ (IEEE DEIS)

Sharing Session on the Future of Electricity Industry

(….continued from page 1)

Two distinguished speakers were invited to present their lecture at this seminar. The first speaker was Ir Dr Mohd Fadzil Mohd Siam, the Chief Strategy Officer of TNB Research Sdn Bhd. His lecture entitled "Reimagining Grid of the Future – Our Roles and Perspective" focuses on the changing energy industry landscape in Malaysia, and TNB's roles to support the Malaysia Electricity Supply Industry through its 'Reimagining TNB' strategic initiatives. The second lecture was given by Professor Paul Lewin, Head of Electronics and Computer Science, University of Southampton. His presentation entitled "Future Electricity Networks – Ensuring Reliable Electrical Transmission and Distribution" discusses the evolution of UK transmission networks and the challenges in ensuring the delivery of a reliable and sustainable electricity network.

Around 30 participants from various universities and industries attended the seminar. Throughout this programme, valuable experiences were exchanged and fruitful discussions were made between the industry and academia within the electrical engineering domain. The committee members of the IEEE DEIS Malaysia Chapter would like to express their sincere thanks to the Institute of Power Engineering UNITEN and the Malaysian High Voltage Network (MyHVnet) for their commitment and support in making this seminar a success.

Assoc. Prof. Dr. Azrul Mohd Ariffin, Universiti Tenaga Nasional.

Various scenes during the sharing session.

Exposure on 500 kV GIL Substation

(….continued from page 1)

commissioned in 2015 to enable the connection between the Janamanjung substation to the 500 kV overhead lines.

There were 20 participants from various academic institutions in Malaysia, including Universiti Tenaga Nasional (UNITEN), Universiti Malaysia Perlis (UNIMAP), Universiti Teknikal Malaysia Melaka (UTEM), Universiti Tun Hussein Onn Malaysia (UTHM), Universiti Teknologi Malaysia (UTM), Universiti Sains Malaysia (USM) and Tunku Abdul Rahman University College (TARC), as well as industry representatives from Tenaga Nasional Berhad (TNB) LABS, who joined the visit. The half-day programme started off with a presentation by Ir. Dr. Iryani Mohamed Rawi, who was part of the team deploying the GIL system, sharing some background about the project and her valuable first-hand experience undertaking it. After the presentation, a site visit was conducted, giving the participants clearer insight and exposure on the system. Then, a visit to the control room that monitors the performance of the GIL system concluded the programme.

The committee members of the IEEE DEIS Malaysia Chapter would like to express their sincere thanks to Grid Maintenance Department, TNB for allowing and accommodating the visit to Janamanjung Main Intake Substation. The support from the members of MyHVnet were also acknowledged for making the industrial visit a successful event.

Assoc. Prof. Dr. Azrul Mohd Ariffin, Universiti Tenaga Nasional.

High Voltage Seminar at Universiti Teknologi Malaysia

The IEEE Dielectrics and Electrical Insulation Society (DEIS) Malaysia Chapter, in collaboration with the School of Electrical Engineering (SKE), Universiti Teknologi Malaysia (UTM), successfully organised High Voltage Seminar on 18 April 2019 at SKE, UTM Johor Bahru. About 100 undergraduate students undertaking the High Voltage Technology course attended the seminar delivered by Ms. Nor Hidayah Rahim, a PhD candidate of the Institute of High Voltage and High Current (IVAT), UTM. Various interesting insights on dielectrics and electrical insulation, especially those related to nanodielectrics, were delivered by Ms. Hidayah during the seminar. Ms. Hidayah also shared with the students about research life at IVAT, high voltage research activities carried out at IVAT, and potential research areas that ones can explore for research purposes.

At the end of the seminar, an educational video about the IEEE DEIS was broadcasted to the students. Through the seminar, it is hoped that the students are aware of the latest research and networking relevant to high voltage engineering apart from obtaining their knowledge through classroom lectures and textbooks. This would allow the students to enhance learning through research information, in line with UTM's effort to enrich the nexus between research, learning and teaching. Course Coordinator Dr. Noor Azlinda Ahmad and Seminar Coordinator Ir. Dr. Lau Kwan Yiew sincerely thank Ms. Hidayah for voluntarily delivering the seminar to the students.

Ir. Dr. Lau Kwan Yiew, Universiti Teknologi Malaysia.

Ms. Hidayah delivering her talk.

University of Malaya rises to 70th place in 2020 QS World University Rankings

University of Malaya (UM) continues improving its position in the QS World University Rankings in 2020 and also remains in the top-100 rank.

In 2020, UM ranks 70th out of 1000 best universities in the world compared to 87th in 2019. There has been a continuous rise in the ranking from one year to another (151st in 2015, 146th in 2016, 133rd in 2017 and 114th in 2018). This is the sixth consecutive year in which UM's position has risen and the second consecutive year in which it has remained in top 100.

UM vice-chancellor, Datuk Ir. (Dr.) Abdul Rahim Hashim said UM has been benchmarking their goals against other top universities in the world in order to keep improving the standard of the university and higher education quality in Malaysia.

The improvement in the 2020 ranking is also contributed by the Department of Electrical Engineering, UM mainly in the publication, research output and citations. It remains in top 50 in the QS World University Rankings in the Electrical and Electronic Engineering category.

One of the active research groups in the Department of Electrical Engineering, which has been contributing continuously in terms of research output and publication, is the University of Malaya High Voltage Research Group (UMHVRG). It is an active research group into dielectrics, electrical insulation and artificial intelligence in high voltage engineering. The group is equipped with the state-of-the-art high voltage laboratory, which is utilized for research, teaching and consultation purposes.

To view the complete QS World University rankings, visit https://www.topuniversities.com/.

Welcome to UTM IVAT

The Institute of High Voltage and High Current (IVAT), Universiti Teknologi Malaysia (UTM) is committed to entertain visits by delegates from not only its own university, but also as far as overseas. The main aim for IVAT organising visits is to share their research, services and consultancy experience to as many people as they could, especially in areas relevant to high voltage engineering.

For interested students from schools or higher learning institutions, the focus of visit would be on IVAT's role in building the nation through their technical support to electrical energy industries to achieve reliable and efficient operations. This is inculcated through their fascinating demonstration on high voltage air discharges (either impulsive or sustainable low current arcs).

For representatives from private companies, IVAT showcases their services and consultancy capabilities, as well as their research achievements, in attempts to increase the return of investments to the university. As for executives of ministerial bodies and government parastatals, IVAT extends their knowledge and experience to open possible collaborations on research works.

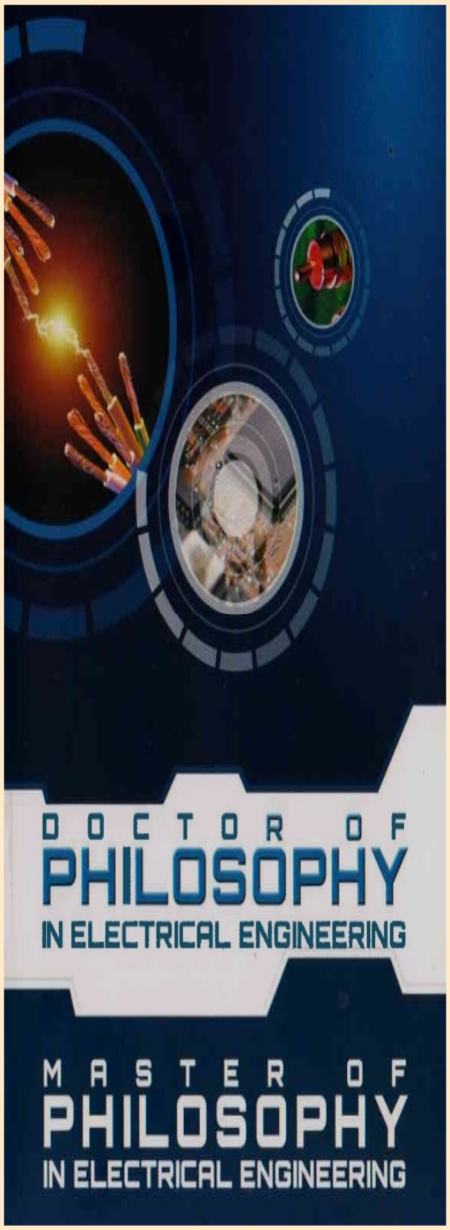
A routine visit to IVAT would include a 5-minute video presentation on IVAT, followed by a 10-minute briefing by an IVAT's academician, then a question-and-answer session on any topic relevant to the visit. Interested parties are most welcome to visit IVAT.

Photos taken during visits to UTM IVAT.

Pursue Your Postgraduate Studies at UTM IVAT

The Institute of High Voltage and High Current (IVAT), Universiti Teknologi Malaysia (UTM), welcomes applications for Doctor of Philosophy (PhD) and Master of Philosophy (MPhil) studies to undertake research projects at IVAT. The themes of the projects include:

- Lightning characterisation, monitoring and detection
- Electromagnetic compatibility and interference
- Partial discharge detection and measurements
- Plasma and ozone generation applications
- Supercapacitors in high voltage applications
- Dielectrics and electrical insulating materials



Admission Requirements:

- PhD:

  Entry to the programme requires a Master degree in Electrical Engineering or equivalent from UTM or other Institution of Higher Learning recognised by UTM. First-class Bachelor graduates (CGPA ≥ 3.67/4.00) may apply for a fast-track PhD (terms & conditions apply)

- MPhil:

  Entry to the programme requires a Bachelor degree in Electrical Engineering or equivalent from a tertiary institution recognised by UTM, with a minimum CGPA of 3.00/4.00 for fresh graduates, or a minimum of 2.50/4.00 with four (4) years experience as an Electrical Engineering practitioner

- English Requirement for International Students:

  All international students must have a valid two-year old TOEFL or IELTS certificate with a TOEFL score of 550 (or 79 IBT) or an IELTS Band 6

Why Study at IVAT?

- Our field of electrical and electronic engineering is ranked Top 100 in the world (according to QS World Ranking by Faculty 2017)
- Our high voltage laboratory is the largest in Malaysia
- We have well-equipped high voltage facilities
- We have widely experienced supervisors working on a variety of high voltage related research and development
- We have dedicated student working areas for office and laboratory work

To Apply:

- Please send your resume with academic qualifications, transcripts and research proposal to the Director of IVAT, Prof. Dr. Zulkurnain Abdul Malek at zulkurnain@utm.my anytime throughout the year. You may also directly contact the respective project supervisors at IVAT.

For more information about IVAT, please visit: http://ivat.utm.my/

For more information about UTM's postgraduate programmes, please visit: http://admission.utm.my/

UTM UNIVERSITI TEKNOLOGI MALAYSIA

Institute of High Voltage and High Current IVAT

PhD studies at University of Malaya High Voltage Research Group (UMHVRG)

Greetings,

We would like to invite applications for Doctor of Philosophy (PhD) studies for projects in University of Malaya High Voltage Research Group (UMHVRG). The scopes of the projects include but are not limited to:

- Partial discharge measurement and simulation
- Dielectric material characterisations
- Artificial intelligence techniques in condition monitoring
- Optimisation techniques in high voltage equipment parameters' estimation
- Other high voltage engineering studies

STUDY MODE: Full-time research (Minimum 2 years, maximum 4 years)

REQUIREMENT:

- Academic qualification:
  - [Bachelor's Degree in Electrical Engineering with CGPA ≥ 3.7 or equivalent] OR;
  - [Bachelor's Degree in Electrical Engineering with CGPA ≥ 3.0 or equivalent] AND [Master by research in Engineering OR Master by Coursework in Engineering with CGPA ≥ 3.00]
- Self-funded or having scholarship
- Proficient in English language (written and spoken)
- Pleasant personality, hardworking and self-motivated
- Ability to carry out research work independently, quickly and efficiently
- Willing to write review and research papers

Advantages of pursuing PhD in UMHVRG:

- Widely experienced supervisors
- Great high voltage laboratory facilities
- Excellent working environment
- Friendly and helpful colleagues
- Top-class facilities in University of Malaya

Interested candidate please send your resume with academic qualifications, transcripts and research proposal to Associate Professor Ir. Dr. Hazlee Illias at h.illias@um.edu.my anytime throughout the year.

For more information on University of Malaya High Voltage Research Group, please visit http://umhvl.um.edu.my

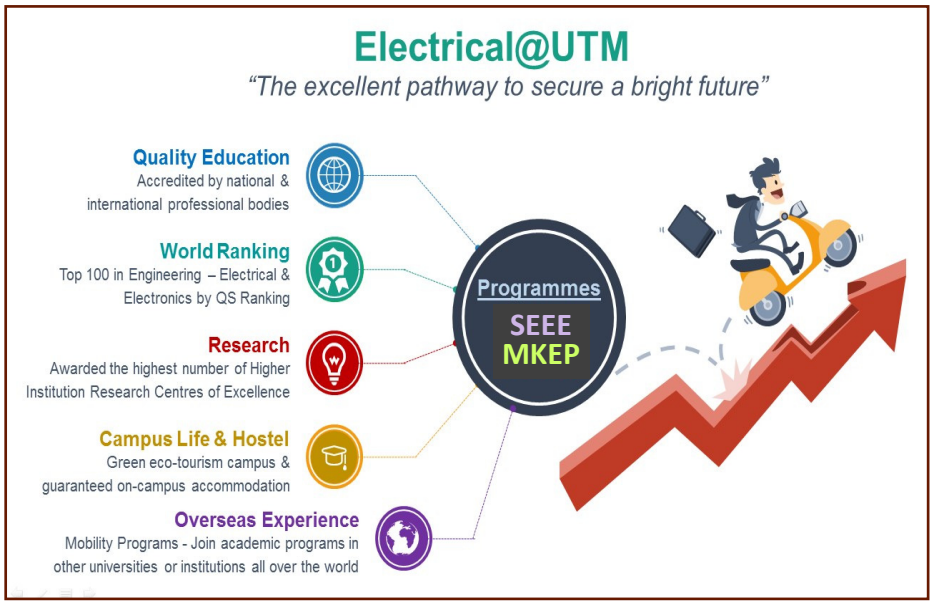
For more information on application of PhD in University of Malaya, please visit https://pgadmission.um.edu.my/

Thank you.

University of Malaya High Voltage Laboratory
Department of Electrical Engineering
Faculty of Engineering
University of Malaya
50603 Kuala Lumpur, Malaysia

Universiti Teknologi Malaysia Improves to #17 in the QS Top 50 under 50 Ranking 2020

Universiti Teknologi Malaysia (UTM) has improved its ranking in Quacquarelly Symonds (QS) World University Rankings by moving up to #17 in the QS Top 50 under 50 Ranking 2020 and is now in the top 20 list of young outstanding universities. This significant performance is largely attributed to the strong commitment by UTM faculty members to provide the best support in facilitating students' learning experience, while harnessing potential talent among students to strive for excellence. UTM is also set to engage in more impactful research collaborations that can ultimately lead to improved performance through joint publications and increased citations. UTM will also continue its efforts in enhancing research collaborations with partners across the globe, especially in areas of mutual interests. This would help UTM researchers to leap forward and stay relevant and visible among peers at the global level. UTM would like to congratulate and thank all staff and students who contributed and put effort into this achievement. To view the complete QS World University rankings, please visit https://www.topuniversities.com/university-rankings/world-university-rankings/2020



The Bachelor of Engineering (Electrical) programme, codenamed SEEE, is one of the undergraduate programmes offered by the Division of Electrical Power Engineering (POWER), School of Electrical Engineering, Faculty of Engineering, Universiti Teknologi Malaysia, to prepare graduates for positions as electrical engineers. The SEEE programme has been designed to emphasise not only on the understanding and acquisition of basic principles and skills in the field of electrical engineering, but also on a wide range of subareas including electronics, control systems, instrumentation, signal processing, telecommunications and power systems. The division also offers the Master of Engineering (Electrical Power) programme, codenamed MKEP, for those interested to pursue a postgraduate degree (by taught course). For more information, please visit POWER's webpage at https://engineering.utm.my/electrical/power/ [Picture courtesy of the Division of Electrical Power Engineering, Universiti Teknologi Malaysia]


1st PTeC2020 & 3rd MyHVnet COLLOQUIUM
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A PLATFORM FOR ALL RESEARCHERS, ACADEMIA AND RELATED INDUSTRY TO EXCHANGE THEIR KNOWLEDGE AND NEW FINDINGS, BESIDES INCREASES THE OPPORTUNITY FOR THE NOVICE RESEARCHER TO BROADEN THEIR KNOWLEDGE AND EXPERTISE
TOPICS / FIELDS
- Power Systems Operations and Control
- Distributed Generations
- Renewable Energy Systems
- Smart Grids
- Protection Systems
- Power Quality
- Electricity Markets
- Reliability Analysis
- Power Systems Simulation and Analysis
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- Integration of Renewable Sources
- HVDC, FACTS and Power Electronics
- ICT for Future Electricity Grids
- High Voltage Engineering
- Electrical Machines and Drives
- Electric Vehicles and Transport
- Condition Monitoring and Diagnostics
- Electrical Services for Buildings
- Transient Analysis and EMTP Modelling
- Power Engineering Education
- Energy Storage
- Other related topics
IMPORTANT DATES
SUBMISSION DEADLINE
8th NOV 2019
EXTENDED !!
NOTIFICATION OF ACCEPTANCE
15th NOV 2019
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15th NOV 2019
LAST DATE FOR PAYMENT
20th DEC 2019
COLLOQUIUM DATE
3rd FEB 2020
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Messages from Advisors of 2020 PTeC and MyHVnet Colloquium

Ts. Dr Zainal Hisham Che Soh, Universiti Teknologi MARA Cawangan Pulau Pinang

Advisor I

Assalamualaikum Wa Rahmatullahi Wa Barakatuh,

In the Name of Allah, the Most Beneficent, the Most Merciful. May the peace, the mercy, and the blessings of Allah be upon you.

Dear colleagues, professors, lecturers, researchers, graduate students, ladies and gentlemen. On behalf of the Faculty of Electrical Engineering, UiTM Cawangan Pulau Pinang, Malaysia, I would like to express my sincere gratitude and welcome you to the 1st Power Technology and Research (PTeC2020) Colloquium and 3rd Malaysian High Voltage Network (MyHVnet) Colloquium. The 1st PTeC Colloquium and 3rd MyHVnet Colloquium is supported and co-organized by Malaysian High Voltage Network (MyHVnet) and IEEE Dielectrics and Electrical Insulation Society (DEIS) Malaysia Chapter. Thus, I would be glad to express my sincere appreciation for their collaboration and support to the colloquium.

I hope the 1st PTeC2020 Colloquium and 3rd MyHVnet Colloquium would be able to achieve its objective in providing an active forum for academician, novice researchers, and practitioners to developing intelligent devices and technology related to power engineering for accelerating industry 4.0 and enriching smart societies. A smart society is the people who have found ways to maximise these opportunities. A smart society leverages the power and the potential of technology to make human beings more productive; to allow us to focus our resources on activities and relationships that matter; and ultimately to improve health, wellbeing and the quality of life. Therefore, the focal drive of this colloquium is to exchange ideas, and by participating in this exchange, it is hoped that all parties may benefit from the colloquium, and to collaborate and to be a part of the latest technological developments in power engineering and science community.

Last but not the least, my deepest gratitude goes to the Advisory Board, Organising Committee, Technical Programme Committee (TPC) members, institutions, companies, and volunteers who have directly and indirectly supported the well-running of this colloquium. The committee has organised a vibrant scientific programme and is working hard to present highly respected speakers to lead it. Although we try our finest to be professional, on behalf of Universiti Teknologi MARA Cawangan Pulau Pinang, please accept our sincere apologies should there be inconveniences that occur before, during, or after the event. I wish you a very productive colloquium with exciting and encouraging discussions and exchange of knowledge so that together we can anticipate a future of groundbreaking knowledge, research, and technology accelerating industry 4.0 and enriching smart societies.

May God bless us all with good health to make this event a successful and enjoyable one!

Advisor II

Assoc. Prof. Ir. Dr. Mohamad Kamarol Mohamad Jamil, Universiti Sains Malaysia.

MyHVnet with IEEE Dielectrics and Electrica Insulation Society (DEIS) Malaysia Chapter have collaborated with Universiti Teknologi MARA (UiTM), Bukit Mertajam, Pulau Pinang to organise the 2020 PTeC and MyHVnet colloquium, which will be held on 3rd February 2020 at UiTM Bukit Mertajam, Pulau Pinang. This 3rd MyHVnet colloquium is the key event for MHVnet, which is the 1st joint colloquium with PTeC this year. We expect that this joint colloquium would provide a platform for researches especially postgraduate students from various academic backgrounds and industrial partners to develop the networking and exchange knowledge, ideas and expertise on wide ranges of high voltage engineering research and their applications as well as in power systems and their applications. I am very pleased to realise that the joint colloquium received an encouraging response from the participants all over Malaysia. Perhaps in the future this event can be opened for international participation.

I would like to extend my sincere thanks to the PTeC and MyHVnet colloquium Chairman and Co-Chairman, Dr Saodah Omar (PTeC) and Assoc. Prof. Ts. Dr Muzamir Isa (MyHVnet) as well as with their team for putting full effort and voluntary contribution for making the colloquium a success. As the colloquium is organised at the northern region of Malaysia, beside gaining a memorable experience at the colloquium, don't forget to take this opportunity to try the best Nasi Kandar in Penang.

Messages from Chairs of 2020 PTeC and MyHVnet Colloquium

Dr. Saodah Omar, Universiti Teknologi MARA Cawangan Pulau Pinang

Chairman

'Together we strong' is the suitable word can we describe for this first collaboration of PTeC and MyHVnet Colloquium. An officially meeting between PTeC, MyHVnet and IEEE DEIS Malaysia Chapter was successfully held at Universiti Teknologi MARA Cawangan Pulau Pinang (UiTMPP) on July 2019 with 20 members from both committees. This is the 1st colloquium for Power Technology and Research Colloquium (PTeC) and 3rd colloquium for Malaysia High Voltage Network (MyHVnet). It was a great opportunity for PTeC to work together with MyHVnet and IEEE Dielectrics and Electrical Insulation Society (DEIS) Malaysia Chapter committees as a team with different field. MyHVnet and PTeC focusing on High Voltage and Power Engineering research respectively. This is a great path for researcher to be united in one colloquium with different field and the sharing knowledge can become more abroad.

In the middle of 2019, PTeC was formed by lecturers from Power Department Faculty of Electrical Engineering UiTM Cawangan Pulau Pinang and focusing on Power Engineering field. The idea of the collaboration began because few of the lecturers from UiTMPP also members of MyHVnet committee. This colloquium will be a platform for all researchers, academia and related industry to exchange their knowledge and new findings, besides increases the opportunity for the novice researcher to broaden their knowledge and expertise.

I would like to take this opportunity to express my thankful to the MyHVnet Chairman, Assoc. Prof. Ir. Dr. Mohamad Kamarol Mohamad Jamil of Universiti Sains Malaysia and Co-chairman of this 1st PTeC and 3rd MyHVnet colloquium, Assoc. Prof. Ts Dr. Muzamir Isa of Universiti Malaysia Perlis for their support, guidance, commitment and assistance towards achieving the collaboration objective. It was a wonderful and fruitful experience for me to bring two committee in one colloquium. Hopefully this is the beginning of the new era of researcher to engage and make PTeC and MyHVnet visible.

Finally, my trust and confidence among committees' members from both PTeC and MyHVnet will never end on strengthening and promoting the colloquium.

Assoc. Prof. Ts. Dr. Muzamir Isa, Universiti Malaysia Perlis.

Co-Chairman

Welcome!

It is my great pleasure to welcome you to the 2020 PTeC and MyHVnet colloquium here in Universiti Teknologi MARA (UiTM), Penang. We are very grateful to UiTM Penang for their tremendous support they have provided as the host and to the colloquium Organising Committee who has given their relenetless effort to ensure all the planned activities go smoothly. We are also fortunate to have the support of a number of attendees who we will get to meet during the colloquium. See you all!

Organiser

POWER TECHNOLOGY & RESEARCH COLLOQUIUM

UNIVERSITI TEKNOLOGI MARA
Cawangan Pulau Pinang
Kampus Permatang Pauh

Co-Organiser

MyHVnet

IEEE DEIS MALAYSIA CHAPTER

1st PTeC2020 & 3rd MyHVnet COLLOQUIUM

Discussion Corner I—Large Scale Solar Photovoltaic Power Plant System Implementations, Trends, Future Development and Challenges in Malaysia

Large Scale Solar Photovoltaic (PV), also known as LSSPV Power Plant are designed from a huge solar PV array for the supply of merchant power into the electricity grid connected systems. In Malaysia, most LSSPVs are typically developed at a scale of at least 1 MWp up to Multi-MWp solar systems. The LSS programme in Malaysia was first introduced as LSS1 by the Energy Commission (EC) of Malaysia in 2016 with the capacity packages ranging from 1 MWac up to a maximum of 50 MWac. This was followed by LSS2 which was launched in 2017 with the capacity packages ranging from 1 MWac up to a maximum of 30 MWac. The third round of the Large-Scale Solar (LSS3) scheme was launched for bidding on August 2019, which aimed for 500 MWp quota with a maximum capacity of 100 MWac for commissioning target in 2021. With the implementation and launch of such a large scale renewable energy project by the Malaysian government, a more lucrative job opportunities in several engineering disciplines should be offered. This will drastically increase studies and research on system implementations which would contribute to trends and future developments of LSSPV systems for improvement in terms of efficiency, timeframe and cost effectiveness of the overall projects. Besides that, issues and challenges on LSSPV to grid interconnection and environment should also be highlighted.

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is a Senior Lecturer in Faculty of Electrical Engineering at Universiti Teknologi MARA (UiTM), Pulau Pinang. He completed his doctoral study (PhD) in 2016 from Universiti Teknologi MARA (UiTM) Shah Alam and Master in Engineering (MEng) of Electrical Energy and Power System in 2006 from University of Malaya (UM). He also granted a few National Funded of Fundamental Research Grant Scheme and ScienceFund for research projects. He was appointed as a technical expert for Green Technology Financing Scheme from GreenTech Malaysia Corporation from 2015 to 2018 and is currently assigned as Associate Consultant for Large Scale Photovoltaic Solar (LSSPV) Power Plant for Kuala Ketil 50 MW Edra Solar Project with Total Power Solutions Sdn Bhd. His current research interests include power electronics converter studies, renewable energy (LSSPV) applications and power quality. Mohd Najib Mohd Hussain is a Member of Board of Engineers Malaysia (BEM) and Institution of Engineers Malaysia (IEM). He is also a Professional Technologist of Malaysia Board of Technologists (MBOT).

Discussion Corner II—Grounding in Electrical Power Systems

The most important part of an electrical power system is its grounding system. A grounding system is functioned to reduce the risk and provide safety to electrical shock from current leakages into uninsulated metal parts of appliances, power equipment or other electronic devices. A lightning protection system is also very important in order to guard against direct lightning strikes to buildings and divert the energy of the lightning strike to the earth without affecting the structure of the buildings. An efficient grounding system should have low resistance to limit the potential differences at ground surface during the occurrence of fault current. Two factors that could affect the performance of a grounding system are the type of grounding electrode used and the characteristics of the soil. Although a grounding electrode is commonly a very good conductor, ageing or life expectancy of the grounding electrode can be a major problem. Regardless of the material itself, a thick coating to the ground electrode would provide better corrosion protection, therefore increasing the life expectancy of the material.

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2020 PTeC and MyHVnet Colloquium

In 2020, Malaysian High Voltage Network (MyHVnet) Colloquium will be held in conjunction with Power Technology and Research Colloquium (PTeC). The colloquium, namely 2020 PTeC and MyHVnet Colloquium, will be jointly organised by Universiti Teknologi MARA, Malaysian High Voltage Network (MyHVnet) and IEEE Dielectrics and Electrical Insulation Society (DEIS) Malaysia Chapter at Universiti Teknologi MARA on 3 February 2020. This will be the third colloquium organised by MyHVnet since its informal inception in 2015 by members from various Malaysian organisations, including TNB Research Sdn. Bhd., AM SGB Sdn. Bhd., Universiti Sains Malaysia, Universiti Malaya, Universiti Putra Malaysia, Universiti Teknologi Malaysia, Universiti Malaysia Pahang, Universiti Malaysia Perlis, Universiti Malaysia Sabah, Universiti Teknikal Malaysia Melaka, Universiti Tun Hussein Onn Malaysia, Universiti Tenaga Nasional, and Universiti Kuala Lumpur. In the 2020 PTeC and MyHVnet Colloquium, the topics of interest have been expanded to include high voltage, power systems, power electronics and renewables. The list of extended abstracts is on page 15. Details of the abstracts can be found on the pages that follow.

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NO.	TITLE	MAIN ORGANISATIONAL AFFILIATION
A001	PERFORMANCE ANALYSIS OF 48 V BOOST CONVERTER DESIGNED FOR TELCO MINI TOWER'S UPS	UNIVERSITI SAINS MALAYSIA
A002	GENERATOR PROTECTION WITH REVERSE POWER RELAY	UNIVERSITI MALAYSIA PERLIS
A003	THERMAL AGING INFLUENCE ON KRAFT PAPER IMPREGNATED IN DIELECTRIC FLUIDS	UNIVERSITI TEKNIKAL MALAYSIA MELAKA
A004	HIGH VOLTAGE ARCING FAULT MEASUREMENT SETUP	UNIVERSITI MALAYSIA PERLIS
A005	THE EFFECT OF ELECTRIC FIELD OF INSULATION IN POWER TRANSFORMER UNDER DIFFERENT GAP DISTANCE	UNIVERSITI TEKNOLOGI MARA
A006	A STUDY ON OIL CONDUCTIVITY USING POLARIZATION CURRENT TEST	UNIVERSITI TEKNOLOGI MARA
A007	EFFECT ON ELECTRICAL TREE PROPAGATION IN XLPE CONTAINING UNTREATED AND TREATED SILICA NANOFILLER	UNIVERSITI SAINS MALAYSIA
A008	ANALYSIS OF FOOT STEPS VOLTAGE GENERATION SYSTEM BASED ON PIEZOELECTRIC	UNIVERSITI TEKNOLOGI MARA
A009	LLDPE-BASED INSULATION MATERIAL FIR HVDC CABLE APPLICATION	UNIVERSITI SAINS MALAYSIA
A010	COMPARISON OF PD PATTERNIN MINERAL OIL AND PFAE UNDER INFLUENCE OF METAL PARTICLES IN QUASI-UNIFORM FIELD	UNIVERSITI SAINS MALAYSIA
A011	IDENTIFICATION OF DISCHARGE INTENSITY LEVEL USING UV PULSE HARMONIC SIGNAL	TENAGA NASIONAL BERHAD
A012	CHARACTERISTIC OF PARTIAL DISCHARGE ON MEDIUM VOLTAGE POWER CABLE WITH POLYNOMIAL REGRESSION	UNIVERSITI MALAYSIA PERLIS
A013	THE EFFECT OF DIFFERENT NOISE LEVELS ON DE-NOISING TECHNIQUE IN PARTIAL DISCHARGE MEASUREMENT	UNIVERSITI MALAYSIA PERLIS
A014	EFFECT OF RTV COATING ON CERAMIC INSULATOR	UNIVERSITI MALAYSIA PERLIS
A015	CURRENT STUDIES ON ULTRA HIGH FREQUENCY AND VERY HIGH FREQUENCY RADIATION RELATIONSHIP WITH INITIAL ELECTRIC FIELD CHANGE IN TROPICAL STORMS	UNIVERSITI TENAGA NASIONAL
A016	RADAR ANALYSIS OF A TROPICAL HAILSTORM ASSOCIATED WITH LIGHTNING FLASH RATE BASED ON LIGHTNING MEASUREMENT SYSTEM USING PARALLEL PLATE ANTENNA	UNIVERSITI TEKNOLOGI MALAYSIA
A017	DESIGN DAN DEVELOPMENT OF HIGH PERFORMANCE RF FRONT END INTERFEROMETER SYSTEM	UNIVERSITI TEKNIKAL MALAYSIA MELAKA
A018	EFFECT OF SUBSTATION GROUNDING GRID SIZES UNDER LIGHTNING TRANSIENT FAULTS	UNIVERSITI TENAGA NASIONAL
A019	TEMPORAL ANALYSIS OF VERY HIGH FREQUENCY AND MICROWAVE RADIATION EMITTED BY CLOUD-TO-GROUND LIGHTNING FLASH	UNIVERSITI TEKNIKAL MALAYSIA MELAKA
A020	MODELLING THE HOT-SPOT TEMPERATURE AND LOSS-OF-LIFE OF ONAN TRANSFORMER BASED ON IEC 60076-7	UNIVERSITI PUTRA MALAYSIA
A021	MODELLING INDIVIDUAL FAILURE RATES OF TRANSFORMER POPULATION BASED ON HEALTH INDEX	UNIVERSITI PUTRA MALAYSIA
A022	DEVELOPMENT OF LOW POWER DC-AC CONVERTER USING ATMEGA328P	UNIVERSITI TEKNOLOGI MARA
A023	A COMPARATIVE STUDY ON ELECTRICAL PROPERTIES OF VIRGIN COCONUT OIL UNDER ACCELERATED THERMAL AGING	UNIVERSITI TEKNOLOGI MARA
A024	STRUCTURE AND DIELECTRIC PROPERTIES OF POLYPROPYLENE/CALCIUM CARBONATE NANOCOMPOSITES	UNIVERSITI TEKNOLOGI MALAYSIA
A025	INFLUENCE OF NON-BRIDGE AND BRIDGE CONTAMINATED TRANSFORMER OIL ON LIGHTNING IMPULSE BREAKDOWN VOLTAGE	UNIVERSITI SAINS MALAYSIA
A026	TREE INCEPTION VOLTAGE IN XLPE CONTAINING ALUMINA NANOFILLER	UNIVERSITI SAINS MALAYSIA
A027	WIRELESS SF6 GAS DISTRIBUTION MONITORING SYSTEM	UNIVERSITI TEKNIKAL MALAYSIA MELAKA
A028	ANALYSIS OF NATURAL ESTER TRANSFORMER OIL UNDER THERMAL AGING CONDITIONS USING UV-VIS SPECTROSCOPY	UNIVERSITI TEKNIKAL MALAYSIA MELAKA
A029	RELATIONSHIP BETWEEN REFRACTIVE INDEX AND TOTAL ACID NUMBER AND WATER LEVEL IN THERMALLY AGED NATURAL ESTER TRANSFORMER OIL	UNIVERSITI TEKNIKAL MALAYSIA MELAKA
A030	FAULT CLASSIFICATION IN TRANSMISSION LINES USING ANN.	UNIVERSITI TEKNOLOGI MARA
A031	A STUDY ON HEAT TRANSFER DISTRIBUTION OF DIFFERENT LENGTH OF GROUNDING ELECTRODE	UNIVERSITI TEKNOLOGI MARA
A032	AN EXPERIMENTAL STUDY ON ULTRAVIOLET SENSOR SIGNAL PATTERN OF DIFFERENT TYPES OF INSULATOR MATERIAL	UNIVERSITI SAINS MALAYSIA
A033	OPTIMIZATION OF CORONA RING DESIGN FOR PORCELAIN INSULATOR STRING	UNIVERSITI MALAYA
A034	MODELLING OF THREE-PHASE VOLTAGE SOURCE INVERTER (VSI) FOR GRID-CONNECTED PHOTOVOLTAIC (PV) GENERATION SYSTEM	UNIVERSITI SAINS MALAYSIA
A035	OPTIMAL PLACEMENT OF PMU FOR COMPLETE OBSERVABILITY OF POWER SYSTEM CONSIDERING ZERO INJECTION AND ISLANDING CONDITION	UNIVERSITI PUTRA MALAYSIA
A036	IMPROVEMENT OF WIND TURBINE LIGHTNING RECEPTOR	UNIVERSITI MALAYSIA PAHANG
A037	CLASSIFICATION OF CABLE JOINT DEFECTS USING OPTIMIZED ARTIFICIAL INTELLIGENCE	UNIVERSITI MALAYA

PERFORMANCE ANALYSIS OF 48V BOOST CONVERTER DESIGNED FOR TELCO MINI TOWER'S UPS

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Abstract – This paper presents performance analysis of 48V boost converter designed for uninterruptible power supply (UPS) for telco mini tower based on duty cycle variations. The converter uses 12V battery bank as its main input supply and it is designed based on boost topology switched mode power supply with a simple voltage control mode scheme. This converter is set to operate at 30kHz switching frequency with a very low ripple voltage in the output stage. Duty cycle in the voltage mode controller is varies from 0.6 to 0.9 in order to observe the effect and performance at the output stage. Simulation and experimental results show that the proposed converter works very well with the 375µH fabricated choke and it produces a stable 48V output voltage with 20mVp-p ripple voltage at duty cycle of 0.8, which is considered good for a regulated DC output.

Keywords – Boost Converter, Duty Cycle, UPS

INTRODUCTION

Nowadays, we witness an increasing number of telco providers with huge amount of subscribers daily. Thus, a reliable uninterruptable power supply for telco mini tower is very critical in order to maintain an interruptible and continuous transmission. Typically, the main power supply for the mini tower is delivered from the national grid and backed up by the fossil fuel generator. With the higher cost of electricity and unpredictable fossil fuel market price, there is higher demand to integrate alternative sources as stable backup power supply while at the same time reducing the operation cost. In this design, solar power has been chosen as the alternative renewable source to charge the battery bank storage rated at 12VDC. The battery bank will then become the main input supply to power the UPS for the mini tower. Finally, the DC-DC converter will convert the 12V to 48V for the transceiver system to operate in interruptible and continuous operation.

METHODOLOGY

In this design, boost topology is chosen as the best topology to be used because it is highly practical for the application with output power less than 150W. Furthermore, the construction can be made simple because no isolation is needed to isolate the input and output. The typical efficiency is also good which is more than 80% and it is also the cheapest to manufacture compared to other topologies [1-3]. SG3524 is selected as the driver circuit to control the power switch using PWM scheme. This controller IC is able to produce switching frequency up to 300kHz and 0.9 maximum duty cycle and it is a perfect choice for the proposed design.

RESULTS AND DISCUSSION

Duty cycle is one of the main parameters that influences the efficiency of the proposed design. Figure 1 shows the simulation result when duty cycle is varied from 0.6 to 0.8 at 30kHz switching frequency. Clearly, the design operates optimally at 0.8 duty cycle and it produces 47.149V output voltage. Duty cycle lower than 0.8 results in lower output voltage whereas duty cycle greater than 0.8 maintains the final ouput voltage value. Figure 2 shows the experimental result when the fabricated design is tested and it produces a regulated 48.2V output with a tiny 20mVp-p ripple voltage.

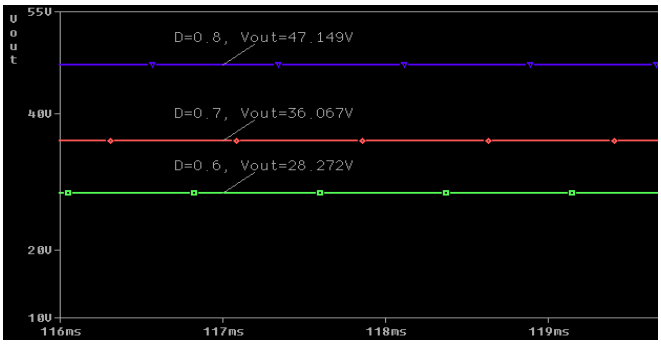

Figure 1: Duty cycle variations from 0.6 to 0.8

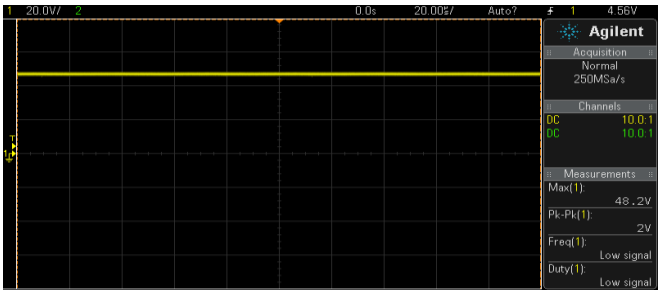

Figure 2: Output voltage of the fabricated converter

CONCLUSION

A reliable 48V boost converter to power telco mini tower's UPS has been successfully constructed. It operates optimally at duty cycle set at 0.8 with regulated output voltage of 48V and only 20mVp-p ripple voltage.

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GENERATOR PROTECTION WITH REVERSE POWER RELAY

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Abstract **–** This paper proposes the modeling and simulation of generator protection for power system using digital reverse power relay. This generator protection considered different examples with two different source synchronous generators 11kV, connected with 220kV through a step-up transformer. The reverse power relay discussed in this paper is high accuracy and high speed digital relays. Several cases based on various types of mechanical inputs to generator were studied. The simulation result done using Matlab/Simulink shows that output of the modelling for 11 kV generator protection is successful and shown a similar results compared to the theory result.

Keywords – Power Protection System; Reverse Power Relay; Reverse Power Protection;

INTRODUCTION

Generators in an electrical power system can be affected not only by electrical and mechanical faults but also internal and external faults. Any fault occurred in the power system should also be cleared automatically and tripping as soon as possible, otherwise it may cause permanent damage to the generator[1]. Hence, preventive measures must be taken to ensure smooth operation and to minimize the fault effect[2]. One of the faults that can occur is the generator reverse flow condition which is caused by the prime mover failure. Prime mover is the mechanical system that turns the generator. If the prime mover fails to supply mechanical energy to the generator, the generator will continue to rotate in motoring mode which means it takes electrical energy from the system instead of supplying it to the system [3]. The reverse power relay is a directional protective relay that is used for the protection of the generating stations to avoid power from flowing in the reverse direction (reverse power flow). This paper proposes the modeling and simulation of generator protection for power system using digital reverse power relay.

METHODOLOGY

The modelling and simulation of generator protection using digital reverse power relay was done by using MATLAB. For testing and simulation of the designed relay, a 200 MVA 11 kV synchronous machine is used, connected with 220 kV network through a step-up transformer 11/220 kV as shown in Figure 1.

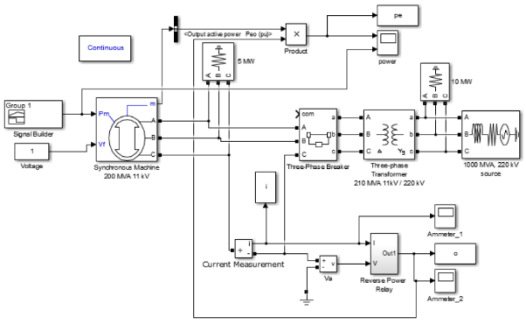

Figure 1: Modelling of Reverse Power Relay in Power System

RESULTS AND DISCUSSION

The relay is tested under three different scenarios. The test conditions and results are given in table 1.

Table 1: Simulation Results for 11 kV Synchronous Machine

Case	Mechanical Input	Time	Result
			11kV
1	0.1pu → 0.8pu.	Increase at 30 sec	Does not trip
2	0.7pu → 0.2pu	Decrease at 30 sec	Does not trip
3	0.6pu → -0.1pu	Decrease at 90 sec	Trip at 91 sec (after 1 sec delay)

CONCLUSIONS

The result shows that output of the modelling for 11 kV generator protection is similar to theory explanation. As compared to other power relay model in existing power system software, MATLAB offers advantage in terms of their flexibility which allow researchers to modify the testing parameters as well as the design of the relay.

ACKNOWLEDGEMENTS

The authors would like to thank Centre of Excellence for Renewable Energy, School of Electrical System Engineering, Universiti Malaysia Perlis, UniMAP for facilities and financial support.

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THERMAL AGING INFLUENCE ON KRAFT PAPER IMPREGNATED IN DIELECTRIC FLUIDS

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Abstract **–**This work compared the condition of oil-papers subjected to thermal aging conducted at 130°C for 750 hours. Results indicate that kraft papers impregnated in palm oil (PO) have better tensile strength after 750 h of aging, compared to kraft papers impregnated in mineral oil (MO). It is concluded that PO is better than MO in delaying the degradation of kraft papers.

Keywords – Mineral oil, Palm oil, Tensile strength

INTRODUCTION

Insulating oil is used as an insulant and cooling medium while paper insulates conductors between turns, windings , and phases. Over time, oil-paper degraded as transformers subjected to stresses (i.e. electrical, ambient, mechanical and thermal), resulting in the remnant life of a transformer to be shortened. One way to prolong a transformer life is by choosing a good insulating oil that could slow down the paper degradation. In this regard, this work seeks to provide pieces of information on the condition of thermally aged oil and paper of different oil-paper combinations.

METHODOLOGY

Two oil-paper combination samples were prepared in this work: (i) mineral oil-kraft paper (MO-KP) and (ii) palm oil-kraft paper (PO-KP). Each sample is inclusive of oil, paper and metal catalysts (i.e. copper, iron, aluminium, and zinc). The weight of the paper is 1:10 of the oil [1]. The accelerated thermal aging process was conducted in a laboratory at 130°C with the absence of air for 750 h. Prior to the aging process, the insulating oils and papers were dried so that it fulfills the requirement for insulating oil and paper in accordance with standards. Next, the paper and metal catalysts were immersed in the insulating oils for 24 h at room temperature. After aging process, samples were taken out from the oven and left at room temperature for 24 h prior to measurement on properties of the oil (i.e. moisture, acidity) and paper (i.e. tensile strength, structure image).

RESULTS AND DISCUSSION

Table 1 tabulated the properties of MO-KP and PO-KP samples. It can be observed that moisture and acidity of both oils are increased after 750 h of thermal aging. Aged oil of PO-KP has higher moisture compared to aged oil of MO-KP. In contras, the acidity of aged oil of MO-KP is higher than aged oil of PO-KP, As for kraft paper, tensile strength was decreased to 3.546 MPa (aged MO-KP) and 8.779 MPa (aged PO-KP), a decrement of 96 % and 90 % respectively, relative to the initial values. Additionally, it is shown that kraft paper samples are darker than their original colour as tensile strength decreased (see Figure 1). The findings might be explained in-term of the ability of insulating oil to absorb moisture. Palm oil; a natural ester has greater affinity towards moisture compared to mineral oil. Therefore, hydrolytic degradation mechanism experienced by kraft paper of PO-KP is lesser than of MO-KP, resulting in slower degradation of kraft paper.

Table 1: Comparison of the properties of thermally aged MO-KP and PO-KP samples

	MO-KP		PO-KP	
Property	New	Aged	New	Aged
Oil				
Moisture (ppm)	18.30	105.10	185.62	714.30
Acidity (mg KOH/g)	0.0442	0.8116	0.0500	0.6652
Kraft paper				
Tensile strength (MPa)	86.485	3.546	86.485	8.779

(a) (b) (c)

Figure 1: Structure image of kraft paper (KP): (a) new KP, (b) KP of aged PO-KP and (c) KP of aged MO-KP

CONCLUSIONS

A natural ester such as palm oil is known to have higher moisture absorption levels compared to mineral oil. As palm oil absorbs more moisture, kraft papers become drier, thus delaying its degradation, resulting in tensile strength and colour preservation.

ACKNOWLEDGEMENTS

Financial support provided by the Universiti Teknikal Malaysia Melaka under the Short Term Grant (PJP/2019/FKE(5A)/S01670).

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HIGH VOLTAGE ARCING FAULT MEASUREMENT SETUP

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Abstract – The occurencence of arc fault or arc flash in the power system may results the interruption of power supply to the electricity user; damage the equipment itself incurs maintenance and interuption cost. The objective of this experiment is to demonstrate the breakdown voltage of the indoor air-gaps (arc fault). The laboratory measurement were performed on the typical indoor air gaps under typical indoor atmosphere conditions.The indicated result shows that the temperature also influence the dielectric strength of air or breakdown voltage of air. As a conclusion, this air gaps or arc generator set up is suitable for modelling arcing fault measurement in the power system network.

Keywords –Air Breakdown voltage, Arc fault, Arc generator

INTRODUCTION

An arc fault is a gas-free discharge anomaly induced by an air breakdown due to the deterioration of the electrical lines or equipment insulation, the loosening of electrical connections, air pressure and/or a sharp increase in voltage or current. The arc is formed due to air gap between energised conductor and a high impedance object. Arc fault can be divided into two categories; series Arc fault and parallel. Series arc fault is the condition where fault current is limited by the load such as poor cable jointing of the same phase, loose cable lugs, bad termination cables etc. In order to study the effect of temperature on the breakdown voltage of the indoor air-gaps, the series circuit of arc generator was setup in the labarotary. The IEEE Standard 1584-2002 provides techniques in determining arc flash hazard due to an arc event in 3-phase ac systems. In standard conditions, the dielectric strength of air is about 3kV/mm [1]. The indoor temperature and humidity effect to the dielectric strength of the air is discussed roughly.

METHODOLOGY

Figure 1 shows the series arc fault set up diagram that been done in this experiement. The BAUR-PGK70HB was used for the high voltage signal injection while Keysight digital oscilloscope DSO-X3024A used for recording the data captured from Rogowski Coil as arc fault sensor. The load represented by 1kΩ resistor.

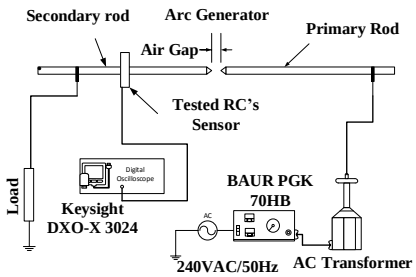

Figure 1: The measurement setup of series arc fault circuit

In this measurement, the series arc geneator model was setup using two (2) copper conductor rod (diameter 10 mm^2); primary and secondary rod**.** These rod presenting the power cable which is arc fault signal travel along the secondary rod until the end**.** Figure 2 shows the real measurement setup of series arc fault measurement that been done in the lab.

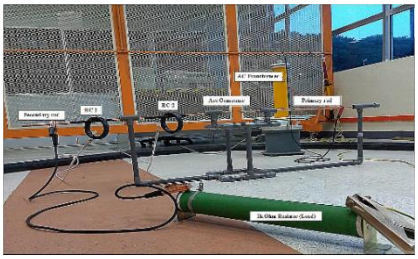

Figure 2: Indoor Modelling of Series Arcing Fault and Setup in the High voltage lab

RESULTS AND DISCUSSION

The arc fault measurement setup is shown in Table 1. As can be seen that, the temperature was effected the dielectric strength of air. At 28.20 °C, the air breakdown was fullfill the theory of dielectric strength 3kV/mm. How ever, with the same distance of air gaps, the breakdown voltage in the air increased significantly when the temperature dropped. The same condition happen to the 2.50mm air gap where the breakdown voltage slightly changed when the temperature changed.

Table 1. The effect of indoor temperature to the dielectric strength (kV) of Arc Generator

Gap Distance (cm)	Dielectric Strength (kV)	Temperature (°C)
0.10	3.00	28.20
0.10	5.00	16.00
2.50	16.0	27.00
2.50	17.00	16.30

CONCLUSIONS

In this paper, the temperature effect due to the arc fault measurement was discussed. It can say that, the changing of the temperature and gap distance could effect the dielectric strength of the air. However, the conductor tip, and insulating material also influced the air breakdown of voltage.

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THE EFFECT OF ELECTRIC FIELD OF INSULATOR IN POWER TRANSFORMER UNDER DIFFERENT GAP DISTANCE

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Abstract **–** This paper investigates the effect of the electric field under different gap distances. The electrodes that were used in this study are uniform and non-uniform. The electric field was obtained by simulating all types of electrodes by using COMSOL software. The electrodes were drawn by using AutoCAD software and the gap distance ranges from 1 mm to 6 mm. The result obtained was sphere-sphere electrode has a higher trend compared to other uniform electrodes, while non-uniform electrodes have the same trend.

Keywords – Electric field, gap distance, mineral oil, uniform and non-uniform electrodes

INTRODUCTION

Insulator is defined as any material that keeps energy such as electricity, heat or cold from easily transferring through. Insulation in power transformers are divided into three types which are liquid, gas or solid. In this study, mineral oil was chosen as an insulator. The electrodes that were used in this study are uniform electrodes which are sphere-sphere, mushroommushroom and plane-plane. While the non-uniform electrodes are sphere-mushroom, sphere-plane and mushroom-plane electrodes. This study is to investigate the electric field between two electrodes under the influence of different gap distances.

METHODOLOGY

The project was done by using two different software. AutoCAD was used to draw all of the electrodes in different gap distances range from 1 mm to 6 mm. COMSOL software was used to simulate the electrodes to obtain the result for the electric field in different gap distances. The electrodes that were used in this study imitates the conductor parts of the power transformer. The dimension of the electrodes is according to the IEC 60156 standard. The voltage was set to 33 kV and the current is 660 A. The insulator for this study is mineral oil. The material that was used for the electrode in this study is brass.

RESULTS AND DISCUSSION

Figure 1 shows the comparison between 6 types of electrodes under different gap distance. The electric field indicates that it is decreases and will remain constant as the gap distance increases. The graph shows that spheresphere electrode has a higher trend compared to other uniform electrodes. Meanwhile for the non-uniform electrodes, the trend almost similar. The percentage of different electric field for sphere-sphere electrode for each gap distance range from approximately 6.25% until 31.65%. While non-uniform electrodes, the percentage difference of electric field for the mushroom-plane electrode range from 9.56 % to 31.33 %. Electric field is the highest in 1 mm gap distance for all electrodes. The electric field was highest for sphere-sphere in 1 mm is 33.95x10^6 V/m. In 6 mm gap distance for sphere-sphere electrode, the electric field recorded was low which is 7.10 x10^6 V/m. In 2.5 mm, the electric field recorded was 14.46 x10^6 V/m.

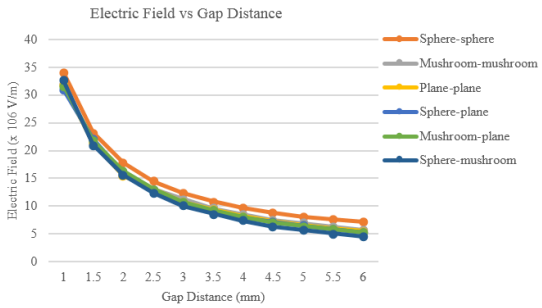

Fig. 1:

CONCLUSIONS

It is found out that the further the distance between two electrodes, the electric field distribution will be evenly distributed but the connection bridge will be less. The voltage and the current across the electrode surface remains the same. The distance between two electrodes increase, the electric field decreases. In uniform electrode, sphere-sphere electrode has higher trend compared to the other two, hence when the gap distance is 2.5 mm, the difference between the three electrode are 1.4 x10^6 V/m. While non-uniform electrodes, there is not much of difference in terms of electric field among the electrodes.

ACKNOWLEDGEMENTS

The author would like to thank the Faculty of Electrical Engineering of UiTM Pulau Pinang and University Sains Malaysia for guiding this study and provide technical support.

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A STUDY ON OIL CONDUCTIVITY USING POLARIZATION CURRENT TEST

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Abstract **–** This research is conducted to study the result of polarization and depolarization current test on petroleum based and natural ester insulating oil. Besides, the result of the polarization current test on the petroleum based and natural esters will be analysed. This research conducted on mineral oil, palm kernel oil, virgin coconut oil and corn oil using polarization and depolarization test. 1 kV has been charged on the insulating oil that placed in a test cell. The small current that pass through the insulating oils will be measured and recorded using Keithley meter. The recorded current has been analysed and conclusions has been made.

Keywords – polarization current test, natural esters, conductivity.

INTRODUCTION

Corn oil (CO) and virgin coconut oil (VCO) are tested in this study. The conductivity corn oil will be study and will be analysed for insulate the transformer. These insulating oils will be tested using PDC test. PDC test is a non-destructive test that can be performed to observe the dielectric properties of liquid insulating materials [1], [2].

METHODOLOGY

The first step is to prepare the insulating oil sample. The capacitance value of the sample has been measured and record. Then, set the connection of the test instrument. Polarization current and has been measured and recorded. After gaining the reading of polarization, the result has been analysed.

RESULTS AND DISCUSSION

After measuring and recording polarization current of the sample, the result has been tabulated and analysed. The lowest polarization current is corn oil and virgin coconut oil polarization conductivity is higher.

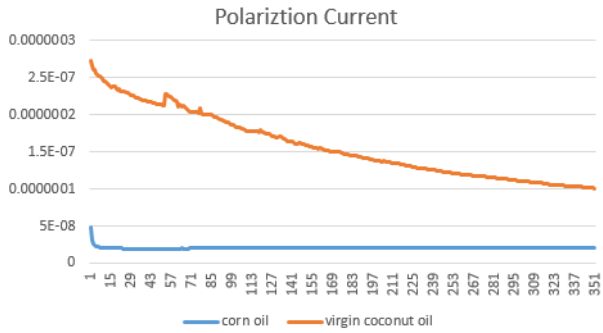

Figure 1: average polariztion current of Corn Oil and Virgin Coconut Oil.

CONCLUSIONS

As a conclusion, from all the data that has been recorded and analysed, polarization current reading of corn oil is lower than virgin coconut oil. this shows that the conductivity of corn oil is lower and can be consider for become good insulator.

ACKNOWLEDGEMENTS

The authors gratefully acknowledge UiTM Pulau Pinang for lab facilities, and USM of Engineering Campus for lab facilities.

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EFFECT ON ELECTRICAL TREE PROPAGATION IN XLPE CONTAINING UNTREATED AND TREATED SILICA NANOFILLER

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Abstract – This paper presents a study on electrical tree propagation in XLPE containing untreated and KH550 treated silica nanofiller. The concentration of silica nanofillers in XLPE was 1 wt%. The result of electrical tree propagation in XLPE filled with untreated and treated nanofiller was compared with pure XLPE composite. The treated silica nanofiller exhibit slower growth of electrical tree in the XLPE nanocomposite.

Keywords – XLPE, Silica nanofiller, Electrical tree

INTRODUCTION

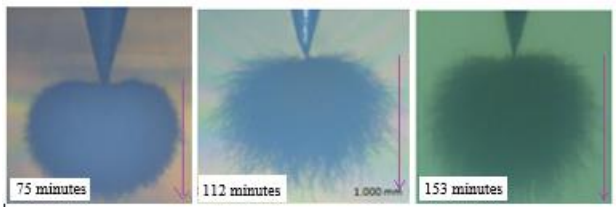
Electrical treeing is the pre-breakdown mechanisms in high voltage cross-linked polyethylene (XLPE) cable insulation. It is expected that by adding nanofiller in XLPE composite can improve the cable insulation performance. The XLPE filled with nanofiller could inhibit the rapid tree growth in the nanocomposite. According to [1,2], polymer containing the inorganic nanofillers can improve the electrical treeing resistance. Thus, this paper investigates the electrical tree growth in pure XLPE and, XLPE filled with untreated and KH550 treated silica nanofiller.

METHODOLOGY

The experimental setup consist of a 50 Hz 240V/ 100kV high voltage transformer, a 10 MΩ limiting resistor and a 1000:1 capacitive divider. The voltage with the rate of 1 kV/sec was applied until the electrical tree inception voltage (TIV) been observed. The TIV was defined when the treeing initiation length has reached 10µm. Then the applied voltage was kept constant at TIV for each sample to investigate the electrical treeing propagation. The propagation of electrical tree was analyzed from needle tip electrode until the electrical tree reaches 1 mm. The concentrations of both silica nanofiller in XLPE was 1.0 wt% with 96% - 99% purity. The size of the silica nanofiller is 20-30 nm. The silica nanofiller are in spherical shape.

RESULTS AND DISCUSSION

Figure 1 shows the images of electrical tree propagation for pure XLPE, untreated silica/XLPE and KH550 treated silica/XLPE after the electrical tree reach 1mm length from the needle tip. The images of electrical tree show the similar bush tree type in pure XLPE, untreated silica/XLPE and KH550 treated silica /XLPE. The result shows that the electrical tree growth takes 75 minutes to propagate in pure XLPE to reach 1mm length from the needle tip. The XLPE containing 1wt% untreated and treated silica nanofiller exhibit slower electrical tree propagation compare to pure XLPE. Furthermore, the 1 wt% KH550 treated nanofiller in XLPE takes 153 minutes to reach 1mm from the needle tip compare to untreated silica nanofiller in XLPE, which was 112 minutes.



(a) (b) (c)

Figure 1: Electrical Tree Propagation
(a) Pure XLPE (b) 1.0wt% Untreated Silica/XLPE
(c) 1.0wt% KH550 Silica/XLPE

CONCLUSIONS

The effect of silica nanofiller in XLPE on electrical treeing propagation has been investigated. The XLPE containing silica nanofiller has inhibited the rapid tree growth in the XLPE nanocomposites. The XLPE filled with 1 wt% KH550 treated silica nanofiller has slower down the tree propagation time compare to pure XLPE and untreated silica nanofiller in XLPE nanocomposites.

ACKNOWLEDGEMENTS

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ANALYSIS OF FOOT STEPS VOLTAGE GENERATION SYSTEM BASED ON PIEZOELECTRIC

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Abstract – This paper presents the analysis of converting force produced by foot steps to generate voltage naturally. The piezoelectric generator is designed using piezoelectric discs, connected to a regulator, DC amplifier and will be stored in 12V rechargeable battery. The output voltages are taken by letting four people of different weight to step on the piezoelectric generator with 0 to 2400 steps. Experiment results show the heaviest people with 2400 steps has produced the highest output volatge which is 12.94V, that considered can light a bulb up.

Keywords – steps, piezoelectric, force

INTRODUCTION

Fossil fuels like coal, petroleum, and natural gas have been world-widely utilized for over one and a half century in human history [1] which substantially harm to environment, wildlife and damage public health. In this studies, analysis of foot step force has been conducted by chosen piezoelectric effect as an alternative method to produce voltage then will save electricity in term of cost. Among the energy harvesters, piezoelectric generators is starting to attract a lot of attention since they can convert the widely available mechanical energy into electricity [2]. Piezoelectric acts as an energy generator, then the produced charge from piezoelectric will stored in the battery. During the testing performed, 2400 foot steps have been experimented with different weight of human body. Finally, inverted circuit is designed to convert generated 12V to AC voltage and light up a bulb. Thus, it could contribute to a more green energy for the public use and create a next step further in innovation instead of continuously depending on the conventional energy source.

METHODOLOGY

The 16 piezoelectric discs are constructing in parallel and connected with the regulator circuit. The discs are used to develop this prototype is piezoelectric disc 20mm with two wires (+ VE and – VE). Force will be applied on the piezoelectric generator by stepping on it. The gained voltage will be connected to the regulator circuit as to let the volatge more stable. Then, it will be amplified by DC amplifier circuit and stored to 12V rechargeable battery. Inverter is used to convert from DC to AC.

RESULTS AND DISCUSSION

Four people with different weight, 28kg, 43kg, 58kg and 70kg have stepped on the piezoelectric generator. The steps are within 0 to 2400 steps, and the output voltages have recorded as shown in Figure 1

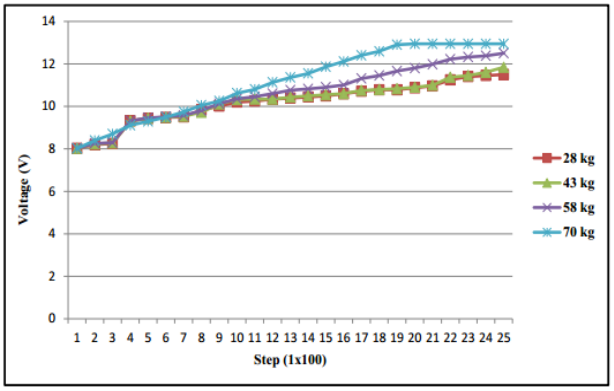

Figure 1: Generated voltage vs foot steps upon four different human body weight

From the Figure 2, the bulb is ON, indicates that there is sufficient generated voltage stored to light up it.

Figure 2: The bulb is ON

CONCLUSIONS

The voltage generation system by applying piezoelectric effect has been constructed and produced optimum generated output voltage of 12.94V. in conclusion, the piezoelectricis an inexhaustible, pollution-free and most importantly, it is renewable energy device. It can be applied at anywhere that need force from foot step such as pavement or house.

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LLDPE-BASED INSULATION MATERIAL FOR HVDC CABLE APPLICATION

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Abstract **–**Nowdays, the use of polymer-based as insulation material for HVDC (High voltage direct current) became increased when there are an increased in demand for using renewable energy such as solar energy This paper presents a review the used of linear low density polyethylene (LLDPE)-based material for HVDC cable application. Comparison and discussion from previous researcher and manufacturer was done in term of performance. The review found, LLDPE based material with additional of nano filler or mixed blanded can improve the properties of HVDC cable insulator. This is because these material have very good indication of the conductivity and dielectric strength of high voltage insulation for HVDC application.

Keywords–HVDC Cables, Polymer Insulation, LLDPE

INTRODUCTION

The influence of the thermal properties of the insulating material is one of the biggest problem in HVDC cable. The operating temperature and thermal conductivity stands out to be the important factor in designing the HVDC cable.

LDPE is linear low density polyethylene that blended form of low density polyethylene (LDPE) where the film has much more flexibility, tensile strength, and more conformability. It is more pliable and softer. LLDPE is used for pond liners or blended into other films to give them more flexibility and extra strength. The difference between LLDPE with LDPE is the thermal resistance and melting point of LLDPE is higher more than 20°C, higher mechanical properties such as elongation break and tensile strength. As LDPE, most researcher try to improve this material dielectric properties by adding or mixed with other material.

THE PERFORMANCE OF LLDPE

Researcher [1] had stated that the addition of nanofiller exhibits the significant reduction in DC conductivity with certain amount, it is not varying with the other fillers to the others materials and give the implication to the movement of charge in the bulk of the material. The researcher [2] found that LLDPE-NR/SiO_2 at 5 wt% to be the best composition for HV insulation in terms of the lowest polarization and depolarization current values as well as the lowest conductivity level.

The DC breakdown strength decreases when the dicumyl peroxide(DCP) content increases in LLDPE-based material at the temperature of 30^{O}C. But when the temperature reaches 70^{O}C and 90^{O}C, the content of DCP obviously has a good impact on the performance of DC breakdown strength in figure 1[3].

The 30HDPE/70LLDPE blend produce higher breakdown strength than XLPE, the breakdown strength is nearly two fold higher than XLPE. For cables service temperature is about 70-90°C, dielectric behaviours of insulation materials at high temperature are of significantly importance. 30HDPE-70LLDPE blends exhibits good properties and stability at high temperature [4].

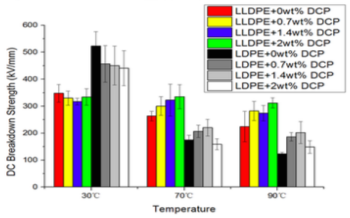

Figure 1: Breakdown strength of LLDPE with DCP content[3]

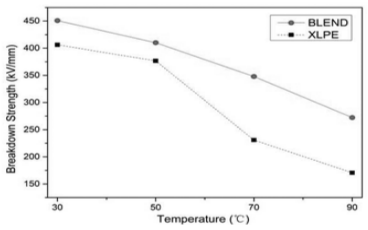

Figure 2: Breakdown strength of HDPE/LLDPE BLEND with temperature[4]

CONCLUSIONS

From the review, the summarize can be made that the performance is determined by the intrinsic of the of the polymer matrix, the composite of the polymer, percentage filler loading, filler size, filler aspect ratio, filler shape and many other factor. One cannot conclude that the thermal conductivity of a several composite depends on a specific parameter without taking into examination on all other parameter also percentage of weightage include.

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COMPARISON OF PD PATTERN IN MINERAL OIL AND PFAE UNDER INFLUENCE OF METAL PARTICLES IN QUASI-UNIFORM FIELD

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Abstract – This paper reports the comparison of PD (partial discharge) in mineral oil and PFAE (Palm Fatty Acid Ester Oil) under influence of three metal particles under quasi-uniform field of AC applied voltage. PDIV (PD Inception Voltage) of three metal particles at 5mm gap distance was measured to be 3.3kV and 4.1kV for PFAE and mineral oil, respectively. The PRPD (Phase-Resolved PD) pattern for each oil appeared to have a distinctive characteristics at 23kV.

Keywords – PD, Metal Particles, Mineral Oil, PFAE

INTRODUCTION

In order to have better understanding on PD activity of metal particle in PFAE, the PD measurement of three spherical metal particles at three gap distances has been conducted. The PD in mineral oil is also measured and compared with PFAE. The results are expected to provide preliminary information for the oil insulation diagnostic in power transformer.

PD MEASUREMENT SETUP

Figure 1 shows the experimental setup used in this study. The AC test voltage is generated by step up transformer rated at 50Hz, 5kVA, 240V/100kV. The supplied voltage was gradually increased in the rate of 500V/s. The PD current pulse was observed and recorded by using 600MHz, 2.5GSamples/s of LeCroy Wavesurfer 64Xs oscilloscope. The PD signals were measured by using a wideband 50Ω impedance matching circuit (IMC) which was designed with a bandwidth of up to 1GHz. The generated PD signals were calibrated by using Haefely Charge Calibrator. A Nikon DSLR Camera was used to record the metal particle movement [1].

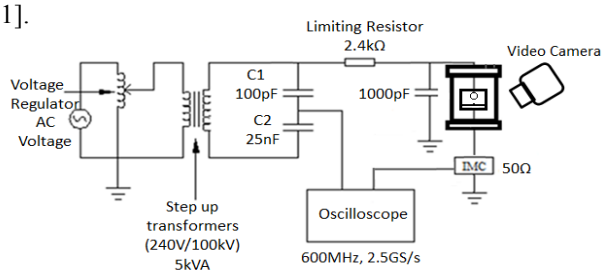
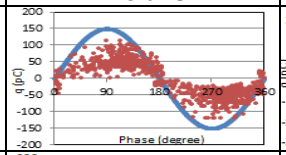
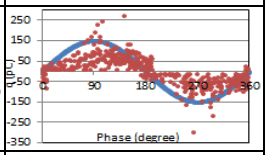
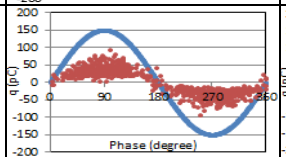
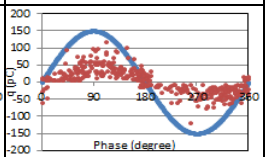
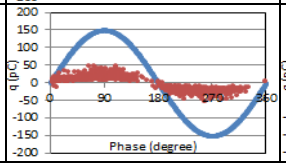
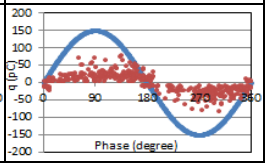


Figure 1: PD measurement circuit diagram.

RESULTS AND DISCUSSION

The PDIV of PFAE was measured to be 3.3kV, 5kV and 6.8kV at 5mm, 7mm and 9mm gap distance, respectively. Meanwhile, the PDIV of mineral oil were around 4.1kV, 6.2kV and 8.5kV at 5mm, 7mm and 9mm gap distance, respectively. Table 1 depicts the PRPD pattern of three spherical metal particles in mineral oil and PFAE at three gap distances at 23kV. The PRPD pattern for both oils was obtained within 150 cycles of applied voltage. The number of PD and PD magnitude for both oils are decreased with the increment of the gap distance. In mineral oil, the PDs distributed all over the phases where the distribution peak is near to 90° in positive half cycle and 270° in negative half cycle. Meanwhile, the PDs in PFAE are scattered all over the phases with the scattering peak around 120° in positive half cycle and 320° in negative half cycle.

Table 1: PRPD pattern of three spherical metal particles in mineral oil and PFAE from 5mm until 9mm gap distances at 23kV.

Gap (mm)	Types of oil	
	Mineral Oil	PFAE
5		
7		
9		

CONCLUSIONS

The PD under influence of three metal particles in mineral oil and PFAE under AC voltage have been compared and investigated. The PRPD pattern is revealed to have a significant different between both oils.

ACKNOWLEDGEMENTS

The author is deeply indebted to Malaysia Ministry of Higher Education and Universiti Sains Malaysia for financially support this work under MyPhD scholarship and Research University Grant (1001/PELECT/814232).

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Identification of Discharge Intensity Level using UV Pulse Harmonic Signal

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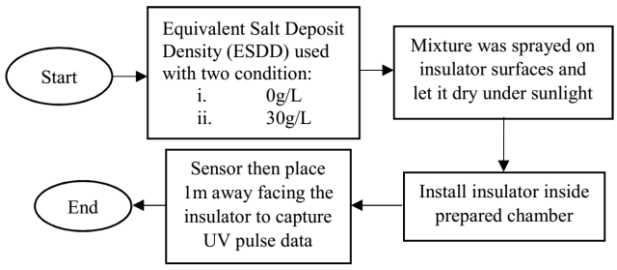
Abstract – Line insulator must be monitor regularly by power utilities company to avoid flashover. There are various method use to identify the insulator condition during operation. Ultra Violet (UV) Pulse method is one of the method use to monitor the insulator surface discharge condition. In this study, harmonic signal of the sensor are discussed. Thus, result shows that, second harmonic can be use to identify the discharge intensity level.

Keywords – Ultra Violet (UV), Flashover, Harmonic, Discharge intensity level

INTRODUCTION

Line insulator contamination and flashover are often relate to one another. Flashover mostly would occur as time goes if the insulator surface condition worsen or contaminated. Thus, condition of the insulator must be monitor and diagnose regularly to avoid future flashover incident. Nowadays, there are many ways of monitoring the conditions of the insulators. Status of the transmission line insulators can be determined by using various method [1]. In this study, by using Ultra Violet (UV) pulse method, the level of insulator surface discharge are being categorized and analyzed [2]. Signal harmonic produced by UV pulse sensor was analyze to identify the discharge intensity level on the insulator surfaces. Additionally, Fourier transform analysis also used to obtain the signal harmonic. The harmonic of the signal produce by the sensor at different level of contamination are then discussed.

METHODOLOGY



RESULTS AND DISCUSSION

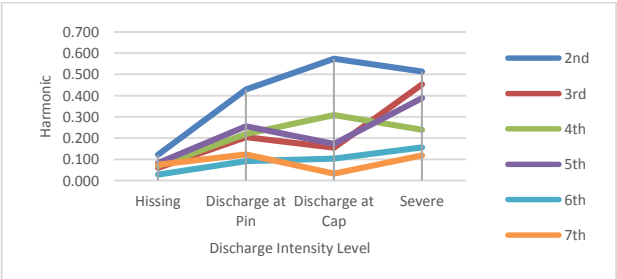


Figure 1: Harmonic signal at 0g/L ESDD

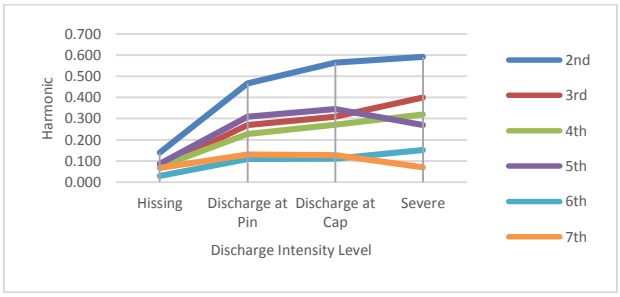


Figure 2: Harmonic signal at 30g/L ESDD

Figure 1 and Figure 2 shows the harmonic signal produced by UV sensor at 0g/L and 30g/L ESDD each. As shown in both figure, as the intensity of the insulator surface discharge increasing from Hissing to Severe, the sixth harmonic of the signal also increased. The second harmonic signal shows highest value for each level of discharge intensity with increasing value from Hissing to Severe level of discharge except for Figure 1. As for other harmonic, it shows increasing value from Hissing to Discharge at Pin for both condition. Same goes to Discharge at Pin to Discharge at Cap level in figure 2. However, it show otherwise for the same level (Discharge at Pin to Discharge at Cap) in figure 1. From these figure, it can be conclude that, second and sixth harmonic of the UV Signal might be a potential variable to identify the discharge intensity level.

CONCLUSIONS

Second and sixth harmonic signal produce by the UV Pulse Sensor can be use to differentiate the discharge intensity level base on the greater changes and linearity for each discharge level. As for others harmonic, it does not seem to be precisely identify the differences for each intencity level. However, combination of UV Pulse method and another method might be able to identify the discharge intensity level precisely.

ACKNOWLEDGEMENTS

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CHARACTERISTIC OF PARTIAL DISCHARGE ON MEDIUM VOLTAGE POWER CABLE WITH POLYNOMIAL REGRESSION

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Abstract – This paper proposes a statistical approach in polynomial regression to identify partial discharge (PD) signal characteristics based on on-site measurement using Rogowski coil (RC) sensor. In this study, data from on-site measurements were used for statistical analysis. In order to obtain numerical parameters from the measurement data in the independent variables, the tests are designed to identify the PD trends between the amplitude signal and the time to reach the peak signal. In this research, the residual regression technique was also used to indicate whether the models fit the data. The result shows the best value to fit between amplitude and peak time with R-square 90.12 percent.

Keywords – Partial Discharge, Characteristic, Power Cable, Polynomial Regression.

INTRODUCTION

PD is a localised dielectric breakdown of a small portion of the high-voltage (HV) electrical insulation system [1]. PD may propagate in high voltage equipment with defective insulators or insulation systems until the insulation is weakened and the insulation has failed completely [2]. Techniques for measuring the properties of the signal strength at both low and high amplitude can be used to determine the trend of PD and to enhance the decision-making process for the health of the insulation. This paper proposes a statistical analysis model using polynomial regression to identify the characteristic PD patterns based on RC-based on-site measurement.

METHODOLOGY

Based on the results reviewed, this paper uses regression as a statistical analysis to derive PD characteristics. Data were recorded using a digital oscilloscope, model Lecroy Wavesurfer 3024 200 MHz, 4 GS/s on-line condition at 6.75 kV to 11 kV supply. The cable type used is 11 kV 3 core XLPE of 150 mm^2 with a length of 560 metres. RC[3] is used as a PD detector for this work. The data for analysis is based on 19 on-site measurement sets where the independence parameter is the level voltage injection and the dependence parameter is the peak PD signal amplitude. The regression equation shall be used as;

$$f(x) = p1*x + p2 \quad (1)$$

Where p1 is the time to reach the peak, x is the error and p2 is the amplitude of the PD signal. Output will be based on the percentage of the coefficient of determination (R-square) and the Root Mean Square Error (RMSE). Then the study further with residual analysis suggests that the model does or does not fit the data.

RESULTS AND DISCUSSION

Figure 1 shows the regression of PD with correlations of all 19 independent variables. The result shows that many correlation pairs are highly correlated with this lead in defining the PD intensity in which the overall model performance is still strong with SSE 0.0002876, RMSE 0.0039944 and R-square 0.9012. Figure 2 demonstrates the residual analysis of the same data to support the regression analysis. The result shows that the marker tends to be randomly distributed over zero showing that the model is a good description of the results.

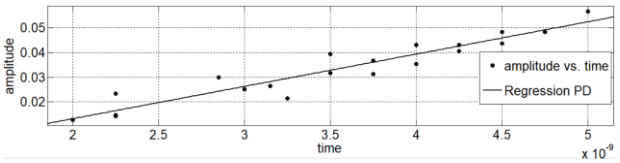

Figure 1: Polynomial Regression of PD signal

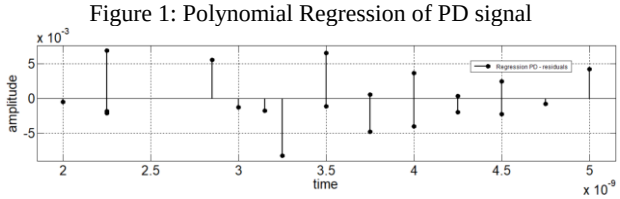

Figure 2: Residual Regression of PD signal

CONCLUSIONS

Characteristics of the PD signal on the MV power cable based on the on-site measurement using RC as a detector is successfully defined using the method presented. Regression analysis provides valuable yield to further improve cable insulation condition and maintenance routine.

ACKNOWLEDGEMENTS

The authors are grateful to the Ministry of Higher Education and UniMAP for their support through the SLAB Schemes.

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THE EFFECT OF DIFFERENT NOISE LEVELS ON DE-NOISING TECHNIQUE IN PARTIAL DISCHARGE MEASUREMENT

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Abstract **–** This paper presents an effect of different noise levels in Partial Discharge (PD) measurement by analyzing its de-noising performance based on Mean Square Error (MSE) value for five different mother wavelets. The mother wavelets are Haar, Daubechies (db), Coiflets (coif), Symlets (sym) and Biorthogonal (bior) wavelet. The analysis are carried out for three conditions of noise amplitude levels which are noise lower than, equal to and higher than PD amplitude level. Highest noise level has highest MSE value which indicates that the effectiveness to remove noise in PD measurement will be lesser.

Keywords – Partial Discharge, De-noising, Noise, DWT

INTRODUCTION

In the PD measurements, the measured signal that captured by the PD sensor is suppressed by noise. Compared to the traditional Fourier transform, it more appropriate to use wavelet transform as de-noising technique since it can works in both domains of time and frequency [1]. The ability to discriminate noise, required knowledge of both the PDs and the noise. Thus, analysis study of the effect of different noise levels on the de-noising technique in PD measurement is essential [2].

METHODOLOGY

The amplitude of PD signal is kept constant at 0.008V. The MSE value is calculated using designated system via LabVIEW software. Table 1 shows the samples of the data collection.

Table 1: MSE value data collection sample for five wavelet families with different noise level.

Mother wavelet	No. of order	Result of MSE value ($\times 10^{-6}$)		
		Lower noise	Noise equal to	Higher noise
		0.004 V	0.008 V	0.012 V
haar	1	0.7542	2.9405	6.3664

RESULTS AND DISCUSSION

Figures 1(a) to 1(d) show the bar chart of MSE value for five different mother wavelets. It can be seen that the the higher the noise level as compared to the PD signal, the higher the MSE value. This means the difficulty to remove noise from measured PD signal is also increased.

CONCLUSIONS

Even the mother wavelet that had most minimum MSE value is chosen as the optimum de-noising technique, the noise level of the PD signal also could affect the effectiveness of de-noising processed.

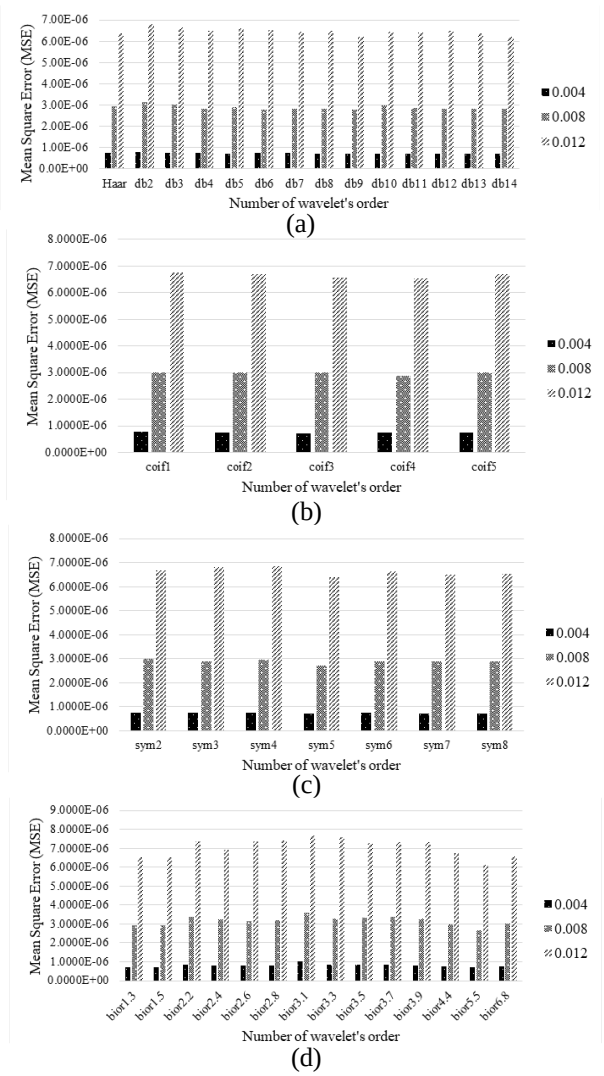

Figure 1: MSE value of (a) Haar and Daubechies, (b) Coiflets, (c) Symlets, and (d) Biorthogonal wavelets.

ACKNOWLEDGEMENTS

Thanks to MoE and UniMAP through SLAB scheme.

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Effect of RTV Coating on ceramic Insulator

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Abstract **–** The percentage of pollution on transmission line insulators at one of cement industrial company located near the Southern Region of Peninsular Malaysia are getting worse due to cement production in large scale and heavy salt pollution with relatively low humidity and dry climate. Presence of pollutants on porcelain insulator surface will contribute to a serious hazard and leads to system outages. This research presents a study on effect of Room Temperature Vulcanize (RTV) coating to improve electrical performances of a porcelain insulator string and its effect towards environmental pollution. For experimental works, porcelain insulator is tested and flashover voltage was evaluated under clean and contaminated conditions. 2-D model of porcelain insulator string were simulated using Finite Element Method (FEM) and voltage and electric field distribution were evaluated.

Keywords – Porcelain insulator,Room Temperature Vulcanize, Flashover voltage.

INTRODUCTION

Room Temperature Vulcanize (RTV) coating have been selected as the most alternative way to recover electrical power insulation performances in ceramic insulator due excellent hydrophobicity, excellent electrical insulation properties, excellent self-cleaning and water resistance and excellent arc resistance for preventing insulator surface from pollution. The coating have been proven to decrease the number of flashover voltage and lengthen the ceramic insulator lifespan that can achieve up to 15 years based on the manufacturing material [1].

METHODOLOGY

RTV coating contains of hydroxyl end-blocked polydimethylsiloxane, reinforcing filler, crosslinking agent and catalyst[2]. Insulator should be dried and cleaned before coated procedure has been applied due to avoid water from destroying the coating on the insulator surface. Spraying method is priority compared to dipping and brushing where the number of layer required two or three layer for thickness from 0.3 mm to 0.5 mm.

RESULTS AND DISCUSSION

Figure 1 shows the effect of RTV for the electric distribution. From simulation, it shows that the electric stress close to pin or high voltage input are highest compared to other surface of the insulator. The bottom insulator represent in red color has a “hot” temperature due to resistance heating along the insulator surface. The second upper insulator are “cold” represented as blue and green color with a low resistance though the insulator surface and the upper insulator is the best insulator represented with all blue color and has lowest surface heating as a result of surface leakage currents created by strong electrical field.

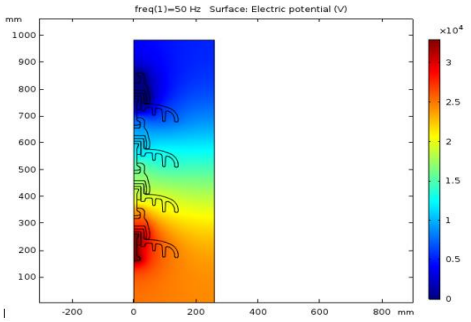

Figure 1: Voltage distribution

CONCLUSIONS

RTV Coating can be used for ceramic insulator string especially nearby the coastal areas which having heavy contamination and wet weather environment. It can significantly improve insulation protection level, prevent from flashover and increase power system reliability.

ACKNOWLEDGEMENTS

The authors would like to thank Centre of Excellent for Renewable Energy, School of Electrical Systems Engineering, Institut Voltan Arus Tinggi (IVAT), Universiti Teknologi Malaysia, Tenaga Nasional Berhad (TNB), Alor Setar for supporting this research and to acknowledge the support from the Fundamental Research Grant Scheme (FRGS) from the Ministry of Education Malaysia.

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Current Studies on Ultra High Frequency and Very High Frequency Radiation Relationship with Initial Electric Field Change in Tropical Storms

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Abstract – The full mechanism of lightning flashes is still not clear. To observe the lightning process several sensors were used to capture the electromagnetic wave from lightning flashes. The key findings in this research is to see that is the initiation of lightning flashes were started with microwave radiation burst or VHF pulse vice versa in associated with initial e-change (IEC) process. Previous has shown that, strong VHF burst related to fast positive breakdown (FPB) [1] was the first event that initiated lightning. However, other school of taught believe that, the initiation of lightning is peak at microwave radiation. This research will provide and help us to understand the initiation process of lightning flashes.

Keywords – Initial Electric Field Change, Lightning Initiation, Fast breakdown

INTRODUCTION

Initial electric field changes (IECs) is a small amplitude, short duration, slow developing E-field change that occurs just before the first initial breakdown (IB) pulse in a lightning flash [2-4]. The duration of IEC process can be determined when there are slow E-field changes starting at zero moving upwards for negative CG (-CG) flash or downwards for Intra-cloud (IC) flash and ended at the first IB pulse.

METHODOLOGY

The results of measurements were obtained from a single station consists of a broadband electric field (E-field) change system with decay time constant of 13 ms and 1s, a Very High Frequency (VHF) E-field system centre frequency of 60 MHz, a Microwave sensor operating around 1 GHz and a pair of orthogonal wideband B field system [4]. The output from antennas is digitized at rates of 5 MS/s, 125 MS/s and 2.5 GS/s with resolution of 12 and 8 bit. Data records were event triggered and were 1 s long for Fast Antenna and 200 ms for both VHF and MW systems. The timing for each event was provided by a Global Positioning System (GPS) with accuracy of ±6 ns. Additional details of the E-field instrumentation are given in [4].

RESULTS AND DISCUSSION

Figure 1 shows one of measurement data recorded during close lightning in UTeM, Malacca. Clearly, the microwave and VHF radiation was detected along with fast antenna system.

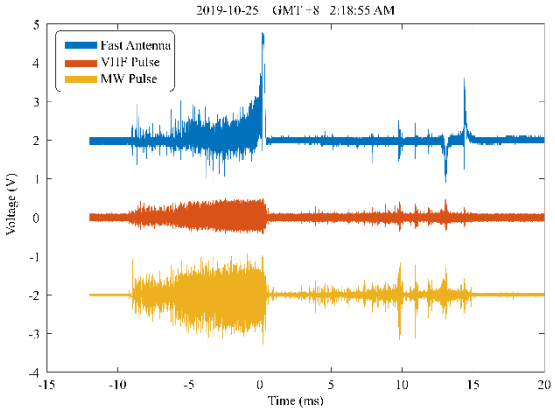

Figure 1: Negative cloud-to-ground (–CG) flash (within reversal distance) captured at 2:18:55 AM l on October 25th, 2019 (Diagram based on atmospheric sign convention).

CONCLUSIONS

The IEC process from tropical storms in Malaysia has been observed. The IECs was preceded by an IB process in all cases. In this research, the additional systems will be provided that believe will give us more information regarding the lightning initiation process.

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RADAR ANALYSIS OF A TROPICAL HAILSTORM ASSOCIATED WITH LIGHTNING FLASH RATE BASED ON LIGHTNING MEASUREMENT SYSTEM USING PARALLEL PLATE ANTENNA

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***Abstract* – Study of electric field measurement by differentiating the design of antenna based on its air gaps and areas were conducted. Using cross correlation method, result were obseved to find a suitable antenna desgin. Then, a study of a hailstorm event were observed based on its flash rates, reflectivity and present of strikes were conducted.**

Keywords – Electric field, cross correlation method,

INTRODUCTION

When lightning strikes occur, one of the components that were generated is vertical electric field. This field can be observed with a field mill, or a flat plate antenna [1-3]. Based on previous studies, a new comparative study of four main designs were tested that compared by its gaps between the parallel plate and the area of the antenna. The waveforms of the captured signals were applied with a cross correlation method that compares the shape of the waveforms. It is observed that an increment of precipitation in the clouds have gradual increment of lightning activities. Combining the data of flash rates obtain from the lightning measurement system that were deployed in UTeM, Melaka, radar data was observed together with WWLLN for their strike location.

METHODOLOGY

Captured electric field signal from lightning flashes were observed by varying air gaps and area of the antennas. Four antennas follow by gap size; Antenna A (3cm), Antenna B (5cm), Antenna C (10cm) and Antenna D (10cm with smaller area). To ensure all signals captured by the antennas were the same, cross correlation method was applied to selected waveform which compares the shape of the waveform. Observation was made based on the value of leading or lagging of the waveforms compared to the reference antenna. Hailstorm was observed in Melaka for its flash rates, composite reflectivity and Plan Position Indicator (PPI) from radar and WWLLN on 14 September 2016. Radar data were observed for cross section of active region of thundercloud and movement tracking. WWLLN data was used for location based on latitude and longitude which can be pinpointed in Google Maps.

RESULTS AND DISCUSSION

Antenna A captured the lowest amplitude, followed by antenna B, D and C. Antenna C had the highest amplitude as it was fabricated with the largest area and largest air gap. Based on all the targeted waveforms, the leading and lagging value were acceptable with the highest value of 4.

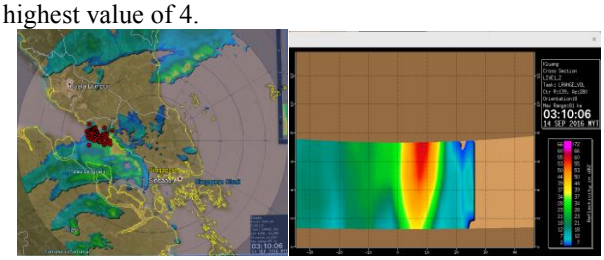

Figure 1(a)(left) shows CAPPI and WWLLN data overlaid together, 1(b)(right) Cross section of the highest reflectivity value of CAPPI

Based on that figure 1(a)(b), CAPPI data shows a high precipitation which was observed based on its reflectivity value indicated by the intensity on its colour gauge. The active region covered the area where the severe thunderstorm was reported to occur. It was also observed that lightning strikes captured by WWLLN were concentrated at the active region. Upon further investigation, PPI data that shows the cross section of the thundercloud such in Figure 1 (b) observed a high reflectivity value of 55 to 60 dBz indicated in red.

CONCLUSIONS

The increment of air gaps and area of antenna will increase the amplitude captured thus increasing the measurement sensitivity of the antenna. The active region of the thunderstorms shows a concentration of lightning strike and a high reflectivity value when it was observed at its cross section.

ACKNOWLEDGEMENTS

Authors express acknowledgement and gratitude for the support given by Universiti Teknologi Malaysia (UTM) under Q04G19 and R4F966 research grants (FRGS) for this project.

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DESIGN AND DEVELOPMENT OF HIGH PERFORMANCE RF FRONT END INTERFEROMETER SYSTEM

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Abstract **–** Microwave admission from lightning has been detected recently, this study will design frontend interferometer to detect the location of the lightning by using antenna, low noise amplifier and band pass filter respectively. The design specification of the antenna is operating on 1GHz frequency and most be almost omni directional with good gain to cover high range distance. The low Noise Amplifier (LNA) is also operating on 1GHz and we had achieved it with operating frequency from (800 - 1.2) GHz with gain of 14.69dB at 1GHz. The Band Pass Filter had achieved to filtering the signal within frequency of (950 – 1050) MHz and damping all the undesired frequency. Interferometer for lightning remote sensing contents of three Systems of antenna, LNA and BPF to be placed one in the centre and two as perpendiculars with distance $\lambda = 0.3$m.

Keywords –Antenna, Low Noise Amplifier, Band Pass Filter, Lightning Remot Sensing.

INTRODUCTION

It is known that lightning dischargesn ormally radiate broadbande lectromagneticw aves in the frequency range from ELF/VLF through VHF/UHF [1]. There are two main thechniques to locate the lightning discharge which are Time of Arival (TOA) and Interferometer [2][3]. The amplitude of the microwave signal is very small that's why the microwave admissions are believed to be associated with the electron avalanche break down process[4] , so in order to detect the microwave radiation with higher magnitude we need to design BPF with more efficient which mean more flatting for passing the frequency from (950 – 1050) MHz only to avoid the interfering with GSM frequency in Malaysia which is operating at 900MHz.

METHODOLOGY

The antenna designed by CST as parallel plate air gab and its spicifications are more than 15MHz band width within (0.9-1.2)GHz for the center frequency of 0.99GHz with return loss S_{11} less than -30dB. The design of the low noise amplifier done by ADS softwar and the spicification are gain above 10dB within the range of (0.97-1.02)GHz with return loss S_{11} less than -20dB at 1GHz. The design of BPF done by ADS with scpicification of good and flat band width from (950-1050)MHz with returne loss S_{11} less than -20dB at 1GHz. All the previous designs fabricated by using FR-4 substrate.

RESULTS AND DISCUSSION

The antenna mesurement results are 29.12MHz band width within (0.7-1.2)GHZ for the center frequency of 1GHz with return loss S_{11} -21.6dB. as shown in Figure 1.

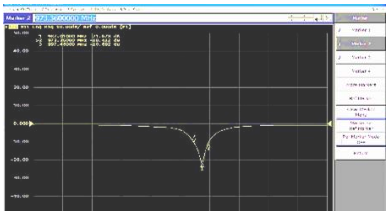
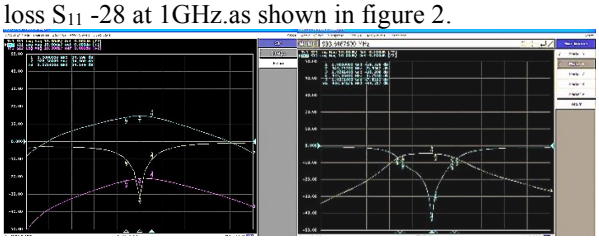


Figure 1: Parallel antenna Air Gab Fabrication results

The LNA achevemnt mesurements results are high gain with S_{21} about 14dB for the range of (0.97-1.02)GHz with return loss S_{11} -33dB at 1GHz with 45MHz band width. Finally, The BPF mesurment shows good results of 86MHz band width from (950-1050)MHz with returne loss S_{11} -28 at 1GHz.as shown in figure 2.



(a) (b)

Figure 2: (a) fabrication results of the LNA, (b) BPF fabrication results

CONCLUSIONS

All the Scpicification results has been achevied with a very good response for the whole system to impliment them for studying the lightning phisecs by using telecommunication system as lightning remot sensing.

ACKNOWLEDGEMENTS

The authors would like to thank UniversitiTeknikal Malaysia Melaka (UTeM) for sponsoring this work under (UTeM Zamalah Scheme).

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EFFECT OF SUBSTATION GROUNDING GRID SIZES UNDER LIGHTNING TRANSIENT FAULTS

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Abstract **–** This paper presents a fundamental analysis of the effect of various substation grounding grid sizes on the transient performance subjected to a lightning fault phenomenon. The analysis is compared between power frequency faults and lightning transient faults in a uniform soil model with high soil resistivity. The consequential effect of various grid sizes on the touch and step voltages, and grid impedance are analyzed using CDEGS software simulation.

Keywords – grid size, lightning, impedance

INTRODUCTION

The existing safety standards are mainly for faults that occurs at power system frequencies (50/60 Hz) [1]. There is no standards available in grounding grid system design which gives a detailed guidelines by considering the transient conditions especially lightning surges [2]. It is important to make sure that step and touch voltages in and around the vicinity of substation are kept below the allowable limits so that power equipment and working personnel at substation are safe during fault conditions [3].

METHODOLOGY

Nine grounding grid sizes are adopted for this simulation and was carried out using the MALT and HIFREQ modules in CDEGS software. The size of the square grounding grid was varied between 10m x 10m and 400m × 400m are made of uniformly spaced 7 transverse and 7 longitudinal conductors. The rectangle grids are varied with the combination of 10m x 30m and 200m x 400m. The grids are buried in the depth of 0.5m. The analysis is compared between power frequency faults and lightning transient faults in high soil resistivity of 5000 Ωm. The lightning fault current injected into the grounding grid is 1000A.

RESULTS AND DISCUSSION

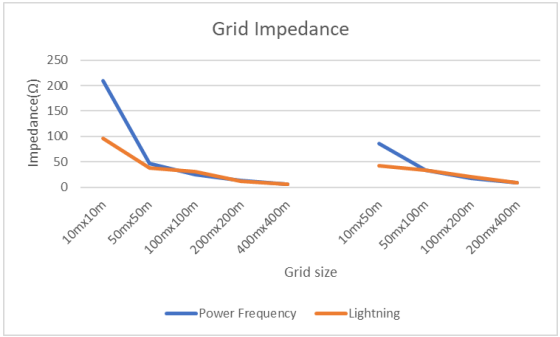

Figure 1: Influence of different grid sizes on impedance at power frequency fault and lightning fault

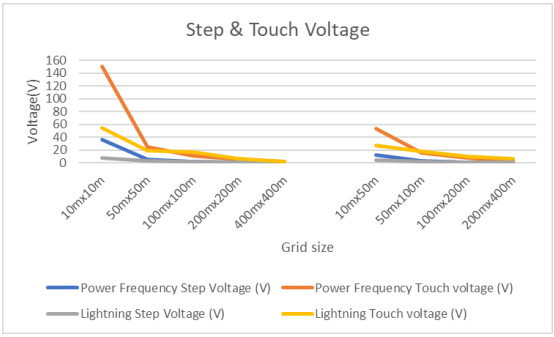

Figure 2: Influence of different grid sizes on maximum step and touch voltages at power frequency fault and lightning fault

CONCLUSIONS

Analysis of step and touch voltages and grid impedance influenced by different grid sizes gives an important impact on the design of substation grounding system. Increasing the grid size produces reduction on the step and touch voltage, and grid impedance in both lightning fault and power frequency faults until it reaches its effective area, beyond which increasing the size no longer reduces the magnitude. For example, increasing the grid size from l0m x 10m to 50m x 50m produces a reduction of 77% in impedance values, while increasing the grid size from 50 x 50m to 100m x 100m results in a further reduction of 48 % for power frequency fault. The reduction of these important parameters improves the safety of personnel working in the substation vicinity and the reliability of power equipment in the substation. Further studies will be done for effects under non-homogeneous soil conditions.

ACKNOWLEDGEMENTS

My sincere appreciation and thanks to Universiti Tenaga Nasional for the guidance given and sharing current practices and knowledge under the project grant Strategic Higher Bold Scholarship.

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TEMPORAL ANALYSIS OF VERY HIGH FREQUENCY AND MICROWAVE RADIATION EMITTED BY CLOUD-TO-GROUND LIGHTNING FLASH

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Abstract – Lightning flash produce electromagnetic waves that radiates at various frequency spectrum band. In this paper, we determined to report observational study of characterization of microwave and VHF radiation emitted by lightning discharge process specifically stepped leader and return strokes using parallel plate antenna that act as remote sensing application with resonant frequency around 1 GHz.

Keywords – Cloud-Flash; Lightning; Microwave Emission; Stepped Leader

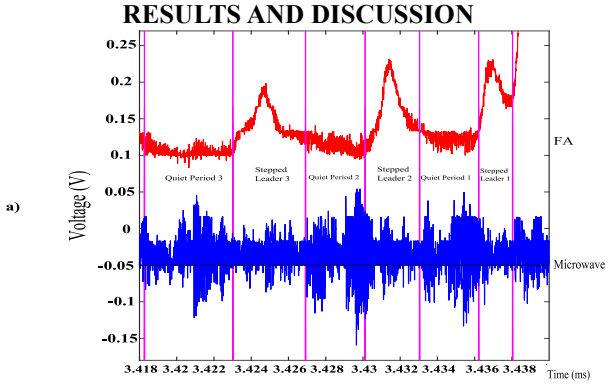
INTRODUCTION

Electrical breakdown process is the process that initiate lightning [1-2]. It starts with electron avalanche that will eventually grows into streamer and streamer will keep growing and turns into leader. Leader is the conducting channel which is the lightning flash form that could be observed with our naked eyes. Electron avalanche was found to associate with microwave as the peak electromagnetic spectrum generated by electron avalanche is around 10^9 Hz [3] while streamer process associates with VHF band. The latest significant study by [4] reported a lighting measurement at 1.63 GHz with a 2 MHz bandwidth using circularly polarized ceramic patch antenna and observes impulses from return strokes were seen to generate high amplitude impulses with continuous burst-noise like bursts while stepped leader generate an oscillating resolvable impulse. Thus, we motivated to observe identical microwave and VHF radiation by using wider bandwidth of antenna.

METHODOLOGY

The lightning measurement is conducted by using an air-gap parallel plate antenna that resonate at around 1 GHz with a bandwidth of 20 MHz for remote sensing application. The specifications of the radio system are between 50-70 MHz and between 800-1050 MHz for VHF and microwave respectively.

RESULTS AND DISCUSSION



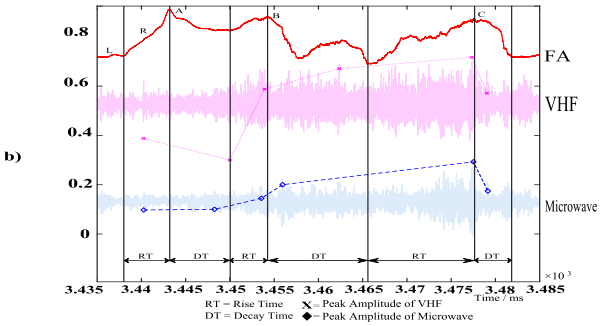


Figure 1: **a)** Magnified view of FA & microwave records of stepped leaders and quiet periods **b)** FA, VHF and microwave radiation plots with peak amplitude in each RT and DT for subsidiary pulses A, B & C.

The percentage ratio of the peak amplitudes of the microwave bursts during QP is between 34.3% and 49.5% larger than the amplitude of the microwave bursts during stepped leaders. The pulse duration of the subsidiary pulses is between 11.991 µs and 16.253 µs. The peak amplitude of VHF radiation impulse is between 59.14% and 75.34% larger than the peak amplitude of the microwave radiation impulses. The highest peak amplitude of VHF and microwave radiation impulses is during the subsidiary pulse C.

CONCLUSIONS

The quiet periods which we believe associates with electron avalanche and streamer is seen to initiate the leader process. Characteristics of VHF and microwave waveforms are noise-like bursts and oscillating individual pulses. During return strokes, subsidiary pulses has the highest peak amplitude of VHF and microwave bursts.

ACKNOWLEDGEMENTS

This project is funded by Short Term Grant (Projek Jangka Pendek PJP/2018/FKEKK/(3B)/S01615) and Fundamental Research Grant Scheme (FRGS) (FRGS/2018/FKEKK-CETRI/F00361).

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MODELLING THE HOT-SPOT TEMPERATURE AND LOSS-OF-LIFE OF ONAN TRANSFORMER BASED ON IEC 60076-7

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Abstract **–**This paper presents hot-spot temperature (HST) and loss-of-life (LOL) modeling for a 132/33 kV, 60MVA ONAN transformer based on thermal model in IEC60076-7. The differential equation approach is utilized whereby 15 days loading and ambient temperature profiles were included as input parameter. Based on the transformer under study, it is found the highest HST is 67.28 °C. The LOL of the transformer after 15 days of loading is 0.0226.

Keywords – Thermal model, Hotspot Temperature, Loss-of-life

INTRODUCTION

Under cyclic loading, transformers can be subjected to temperature variations which can be translated to long term ageing process. For asset management purpose, the knowledge on the hot-spot temperature (HST) and its corresponding loss-of-life (LOL) are essential for proper planning and maintenance activities. One of the common approached to determine the HST and LOL is through thermal modeling [1]. There are different types of thermal models that have been proposed to determine the HST [2, 3]. Differential model in IEC 60076-7 is among the common model that can be used to compute the HST and LOL due to its simplicity and minimum requirement of input data [4].

A study is carried out to determine the HST and LOL of a 132/33 kV, 60MVA ONAN transformer based on differential thermal model in IEC60076-7. Based on the HST, the LOL is calculated based on 15 days of loading data.

METHODOLOGY

The modeling procedure of HST and LOL can be seen in Figure 1. The first step was to obtain data such as 15 days loading profiles, ambient temperature and thermal parameters from temperature rise report and IEC 60076-7. Next, the HST was modeled based on differential model in IEC 60076-7. The LOL is calculated based on the computed HST.

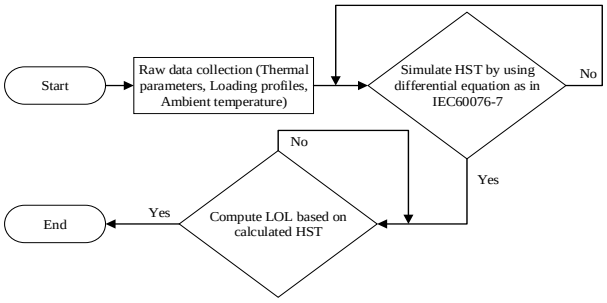

Figure 1: HST and LOL modelling based on IEC60076-7

RESULTS AND DISCUSSION

The HST for the transformer fluctuates accordingly due to the variation of the loading. It is found that the highest and lowest HST are 67.28 ºC and 41.70 ºC as seen in Figure 2. The average HST is 51.81 ºC based on 15 days loading profile.

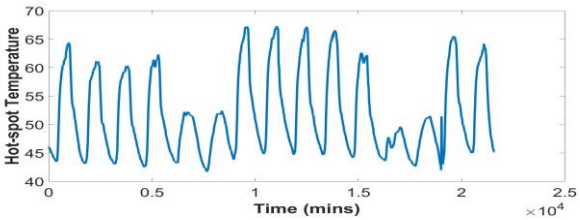

Figure 2: Hot-spot Temperature (HST).

The LOL increases almost linearly with multiple fluctuations during the 15 days loading profiles as shown in Figure 3. After 15 days, the LOL is 0.0226 day which is equivalent to 32.57 minutes.

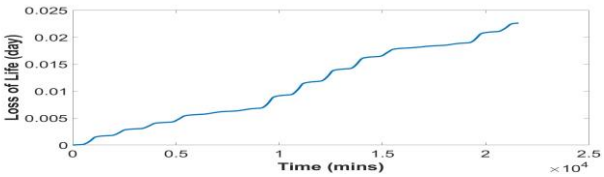

Figure 3: Loss of Life (LOL) in day.

CONCLUSIONS

The HST and LOL of 132/33 kV, 60MVA ONAN transformer has been computed successfully based on 15 days loading profile and ambient temperature. The next step of the study is to further examine the loss of life with consideration on multiple ageing factors.

ACKNOWLEDGEMENTS

The authors would like to express their sincere gratitude to the ALPER UPM and UniKL BMI for the technical and financial support of this research. The research was funded by PUTRA Berimpak (GPB/2017/9570300) and the FRGS scheme (03-01-19-2071FR).

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MODELLING INDIVIDUAL FAILURE RATES OF TRANSFORMER POPULATION BASED ON HEALTH INDEX

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Abstract – This paper presents a study on modelling the individual failure rate based on Health Index (HI). In total, 148 oil samples from 33/11 kV transformers with age ranging from 1 to 20 years were analysed in this study. The HI of tranformers was determined based on the condition monitoring data of the oil samples. Next, the individual failure rate was determined based on the relative risk approach. It is found that, the relationship between failure rate and HI of the transformer population is almost exponential. Majority of the failure rate of the transformer population exceed the average failure rate obtained from global survey at HI lower than 80%.

Keywords – Transformer, Individual failure rate, Asset management

INTRODUCTION

Nowadays, utilities have started to adopt condition-based management for optimizing the maintenance and capital investments of transformers. Historical data is one of the key components for this scheme. Failures data is essential for future planning of networks for the utilities [1]. However, in-service failures data is quite difficult to be obtained due to various reasons [2]. A number of studies have been carried out to estimate the failures data based on available information [3]. One of the unique approaches to determine failure rates is based on condition of the assets [1].

This paper presents the approach to determine the failure rates based on health index (HI) concept of transformers. In total, 148 oil samples from 33/11 kV transformers are analysed.

METHODOLOGY

The workflow of this study is shown in Figure 1. The first step was to obtain the condition monitoring data from the transformer population. The health index was determined based on scoring and weighting method [4]. The failure rate of individual transformer was determined based on relative risk method [1].

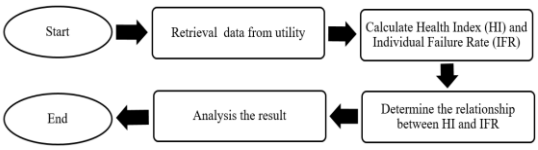

Figure 1: The workflow of the study

RESULTS AND DISCUSSION

The relationship between failure rate and HI can be seen in Figure 2. The failure rate increases almost exponentially as the HI decreases to around 45%. Since the transformer population is quite young, not much data can be obtained at HI region between 45% and below. It is found that the failure rate of the transformer population mainly exceed the global average failure rate once HI decreases lower than 80%.

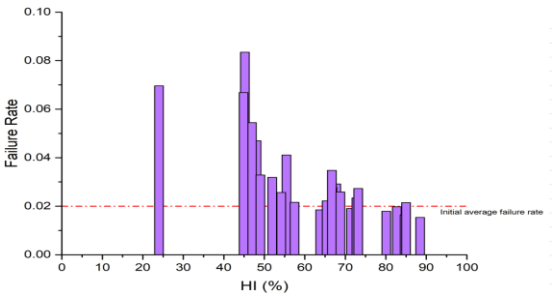

Figure 2: Graph of failure rate versus HI

CONCLUSIONS

Failure rate has an exponential relationship with HI. High failure rate is found as HI decreases lower than 50%. Further study will be carried out to examine the progression of individual failure rate as the age increases.

ACKNOWLEDGEMENTS

The authors would like to express their sincere gratitude to the ALPER UPM and UniKL for the technical and financial support of this research. The research was funded by PUTRA Berimpak (GPB/2017/9570300) and the FRGS scheme (03-01-19-2071FR).

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DEVELOPMENT OF LOW POWER DC – AC CONVERTER USING ATMEGA328P

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***Abstract* – A microcontroller ATmega328p is use to generate the control signal for each switch. This technique is much cheaper for hardware implementation compare to other interface such as FPGA board and DSpace board. The ATmega 328p can store multiple switching scheme. In this study, microcontroller is used to produce different switching scheme such as square wave, quasi-square wave, and 20kHz PWM. MOSFET IRF540N is used to avoid any accidental short circuit occurs. On the other hand, IR2110 is use to drive the MOSFET. The function of this integrated chip (IC) is to ensure the high and low side does not intercept. The inverter is suitable for low power AC equipment such as bulb, speaker and small AC motor.**

Keywords* –** ***Inverter; Square Wave; Quasi Square Wave; Pulse Width Modulation (PWM); H-bridge; Arduino; MOSFET

INTRODUCTION

The main function of DC-AC converter is used to change the DC signal into AC signal also known as inverter. Some of the application of the inverter can be seen in renewable energy application and uninterruptable power supply (UPS).

The state of the art of the converter is based on the semiconductor device application acting as a switch to change the output waveform. As for inverter the AC signal of the input will pass through the semiconductor device base on the switching scheme to produce DC signal output.

The aim of this paper is to discuss the hardware implementation of the small scale DC-AC converter. The implementation also considers cost effecting by using low cost microcontroller to produce switching signal to control the semiconductor applied in the inverter to turn on and off. It is a compact and simple design with selectable switching scheme so that the users can easily choose the switching techniques without having to re-program the microcontroller.

METHODOLOGY

Hardware Implementation

The output signal from the ATmega328p cannot be directly connected to the gate of the MOSFET due to voltage different between ATmega38p output and input voltage to the MOSFET gate. Therefore IR2110 is acting as a driver from the microcontroller with two important task; a) voltage regulator to increase 5 V to 12 V and b) prevent overlapping signal to turn on the MOSFET between positive side and negative side of the converter [1][2].

H-Bridge

A typical H-Bridge inverter with four switches (MOSFETs) is built. Based on the datasheet, 10Ω and 1N4148 fast diode should be added to provide safety margin for delay turn-on time.

RESULTS AND DISCUSSION

The experimental results show that the highest efficiency is produce by the quasi square wave compare to the PWM technique. This is due to PWM switching scheme produce high switching losses.

TABLE 1: THE OUTPUT VOLTAGE, CURRENT POWER AND EFFICIENCY

Switching scheme	V_{P-P} (V)	V_{RMS} (V)	I_{RMS} (A)	P_{IN} (W)	P_{OUT} (W)	η
Square Wave	8.68	3.81	3.176	15.2	12.1	79.6
Quasi Square Wave	12.9	4.21	2.73	14.2	11.49	80.9
20kHz PWM	12.6	4.46	2.25	12.9	10.03	79.8

CONCLUSIONS

Based on the experimental results the efficiency of the converter for low power application shows that quasi square can provide the best performance compare to two others switching techniques. The microcontroller also demonstrates the capability to control the gate signal of the MOSFETs compare to others expensive controller unit such as FPGA, DSpace & Raspberry Pi.

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A COMPARATIVE STUDY ON ELECTRICAL PROPERTIES OF VIRGIN COCONUT OIL UNDER ACCELERATED THERMAL AGING

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Abstract – This paper about a comparative study on electrical properties of virgin coconut under accelerated thermal aging. The main purpose of this project is to study the suitability of virgin coconut oil as transformer oil under accelerated thermal aging. The result will compared to IEC 60156 standard for a breakdown voltage while, for the accelerated thermal aging will compared to ASTM D1934.

Keywords – Transformer, insulating oil, virgin coconut oil, mineral oil, Breakdown voltage, Thermal aging.

INTRODUCTION

Transformers are unit devices used in electrical circuits to vary the voltage of electricity flowing within the circuit. Transformer also is the crucial thing in the power system world so that is important to protect it from any course failure. Insulating oil is an oil that is stable at high temperatures and has wonderful electrical insulating properties. The main functions are to insulate, suppress corona discharge and an arcing, and to serve as a coolant. Mineral oil (MO) is the most common used for transformer as insulating and cooling oil. Even though it is viable, and low cost [1], it also has their own drawback, for example, it has a high flammability, lead to environmental pollution and its insulating properties easily reduce with small amount of water [2]. Hence, vegetable oil is the best alternative to replace and improve this problem. As a vegetable oil base, it is more environmentally friendly, high fire point, renewable and slower ageing rate [2] [1].

METHODOLOGY

There are two type of oil involved in the project which is pure virgin coconut oil (100% VCO) and pure mineral oil (100% MO). The sample will be categorized into 2 parts which is before aging and after aging. Before aging sample is when the sample do not undergo any process before tested. While, "after aging" sample is when the oils are heated in oven for a certain time. In this project sample will exposed to four different periods which 100 hours, 150 hours, 200 hours, 250 hours and 300 hours before they were tested on the breakdown voltage.

RESULTS AND DISCUSSION

Figure 1 illustrates the relationship between breakdown voltage of VCO when was exposed under accelerated thermal aging. Found that, the breakdown of vegetable oil was increased from 0 to 200 hours, breakdown voltage was increased significantly until it drastically rises to the higher value which is 95.9 kV at 250 hours of aging after that it slightly decrease into 79.9 kV at 300 hours different from the mineral oil results which shows the opposite patern. The breakdown voltage of VCO is higher than mineral oil because, as a vegetable oil their chemical structure contains more saturation compare mineral oil.

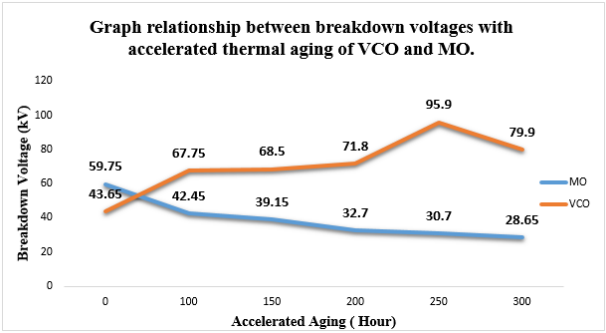

Figure 1: Graph relationship between breakdown voltages With Accelerated Thermal Aging of VCO and MO

CONCLUSIONS

VCO has a higher breakdown voltage when it was exposed under accelerated thermal stress compared to mineral oil. Based on the result, VCO show the positive result, which the breakdown voltage keeps increasing and high probability of being considered as a transformer oil, but the oil still needs to go through a variety of other tests such as acidity, viscosity, moisture and others in order to identify either it is really suitable as transformer oil.

ACKNOWLEDGEMENTS

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STRUCTURE AND DIELECTRIC PROPERTIES OF POLYPROPYLENE/CALCIUM CARBONATE NANOCOMPOSITES

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Abstract **–** This paper reports on an investigation of the effects of multi-element oxide nanoparticles, namely, surface modified calcium carbonate ($CaCO_3$) on the structure and dielectric properties of polypropylene (PP). The morphology and dielectric response analysis were carried out by means of SEM Hitachi TM3000 and Gamry Instruments Interface 1000 with Tettex's 2914 test cell for solid insulations, respectively. The nanocomposites were prepared based on a melt blending technique. Hydraulic laboratory press was used to obtain 100 µm thick sample. The experimental results show that, surface modified $CaCO_3$ nanoparticles were homogeneously dispersed in PP. Meanwhile, the real permittivity of PP/$CaCO_3$ nanocomposites was lower than that of unfilled PP.

Keywords – Polypropylene, nanocomposites, calcium carbonate, dielectric

INTRODUCTION

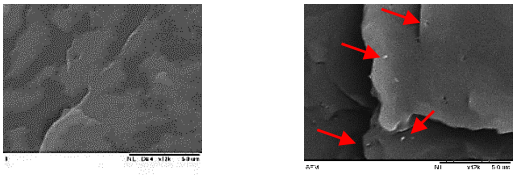
Nanoparticles are widely used to enhace the dielectric properties of polymer based insulation. By introducing few weight percentage (wt%) of nanoparticles, polymer nanocomposites demonstrate different dielectric properties. Previous studies showed unique dielectric properties, e.g., real and complex permittivity, through the use of nanocomposites, such as epoxy/zinc oxide [1] and epoxy/silicate nanocomposites [2]. Thefore, this research was conducted to further investigate the dielectric property of polypropylene (PP) with 1 wt% of surface modified $CaCO_3$.

METHODOLOGY

The based polymer used was PP blend composed of 50% PP homopolymer and 50% PP impact copolymer. The nanofiller used was surface modified $CaCO_3$ with an ammount of 1 wt%. The sample was melt blend using a brabender mixer. The thin film sample was prepared by means of hydraulic laboritory press to obtain 100 µm thick sample. The sample was subjected to Hitachi TM3000 and Gamry instrument interface 1000 for SEM and dielectric response measurements.

RESULTS AND DISCUSSION

Figure 1a and 1b show the micrograph of unfilled PP and PP/$CaCO_3$ nanocomposites, respectively. The SEM micrograph of unfilled PP reveals the structure of PP blends witout having any nanoparticles. the detailed morphology of the unfilled PP blend is not well revealed in this fracture surface. Meanwhile, SEM micrograph of PP/$CaCO_3$ nanocomposites shows that surface modified $CaCO_3$ nanoparticles were well dispersed in PP. In additions, $CaCO_3$ with ~100 nm sizes (as indicated by red colored arrows) could be seen.



(a) (b)

Figure 1: SEM micrograph of (a) unfilled PP and (b) PP/$CaCO_3$ nanocomposites.

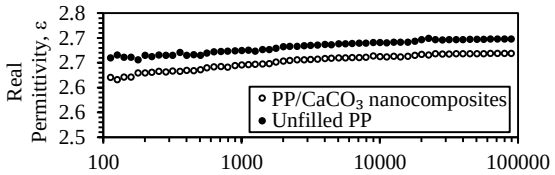


Figure 2: Real permittivity comparing unfilled PP and PP/$CaCO_3$ nanocomposites.

Figure 2 demonstrates the real permittivity comparing unfilled PP and PP/$CaCO_3$ nanocomposites. In is noted that the real permittivity of unfilled PP and PP/$CaCO_3$ nanocomposites are almost independent of frequency over the frequency range of 100 Hz to 100 kHz. The permittivity of unfilled PP was 2.68 throughout the measured frequency range. Meanwhile, PP/$CaCO_3$ nanocomposites had a lower permittivity than unfilled PP. This result is in line with the research in [1]. This is attributed to the interaction between nanofiller and polymer matrix that would restrict the movement of polymer molecular chains, thus reducing the polarisation of the polymer matrix [2].

CONCLUSIONS

This research shows that surface modified $CaCO_3$ nanoparticles have been well distributed in PP polymer. Besides that, the introduction of $CaCO_3$ in PP reduces the permittivity of PP/$CaCO_3$ nanocomposites. This is due to restriction of polymer molecular chain by $CaCO_3$ nanofillers.

ACKNOWLEDGEMENTS

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INFLUENCE OF NON-BRIDGE AND BRIDGE CONTAMINATED TRANSFORMER OIL ON LIGHTNING IMPULSE BREAKDOWN VOLTAGE

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Abstract – This study investigates the influence of bridging formation of impuritiy in a transformer oil on the lightning impulse breakdown voltage. An impulse generator of 280kV was used to provide a positive lightning impulse waveforms of 1.2/50 µs. The rising voltage method of IEC60897 was applied to measure the breakdown voltages. Cellulose Powder of 20µm size were dispersed into oil as contaminant with 0.004% concentration level of fibers by weight. The results revealed that, the contaminant reduces the breakdown voltage nearly 10% and further 14% the bridges formed.

Keywords – Breakdown, Impulse, Contamination

INTRODUCTION

Pressboards are major insulation used in power transformer. During normal operation, pressboard continuously exposed to thermal, electrical and mechanical stresses. Under the influence of these stresses the pressboard may undergo a process of degradation, resulting in the formation fiber dust dispersed into mineral oil as contamination. These fibres particles presence as oil contamination effected the dielectric strength of oil by reduce the breakdown voltage of the liquids[1][2] .

METHODOLOGY

Firstly, a bulk quantity of mineral oil was collected from a sealed barrel and the oil was degassed in a vacuum oven set at 105°C for more than 48 h. Next, the oil was left to cool down to room temperature (15-30˚C) for 24 h under vacuum. The pre-treated oil sample is denoted as clean oil (CO). Commercial microcrystalline cellulose powder with a size of 20 µm was chosen as the contaminant for the tests. The contaminant was dehydrated in a vacuum oven set at 105°C for 8 h in order to remove moisture. The cellulose powder was left to cool to room temperature for 6 h under vacuum condition. Next, a magnetic stirrer was used to disperse the contaminant uniformly in the mineral oil in order to prevent the formation of cloud-like clusters of fiber in the oil. The contaminated mineral oil samples are labelled as non-bridging contaminated processed oil sample (NB_CPS) and bridging contaminated processed oil sample (B_CPS) with fiber particles of 0.004wt%. The lightning impulse breakdown voltages (LIBV) were measured using the rising voltage method (1 shot/step) of IEC60897.

RESULTS AND DISCUSSION

Figure 1 shows the Weibull distribution parameter and 50% breakdown probability of the Clean Oil (CO), Non-Bridge Contaminated Oil (NB_CPS) and Bridge Contaminated Oil (B_CPS). The dielectric breakdown voltage (BDV) of these samples was illustrated in Table 1. The results revealed that the BDV was reduced significantly by 9.84% due to the attendance of cellulosic fibers and the fibers effect become more prominent when the bridge was formed. The fibers accumulated were contributed by a low BDV of contaminated oil up to 23.37% in the bridge formation.

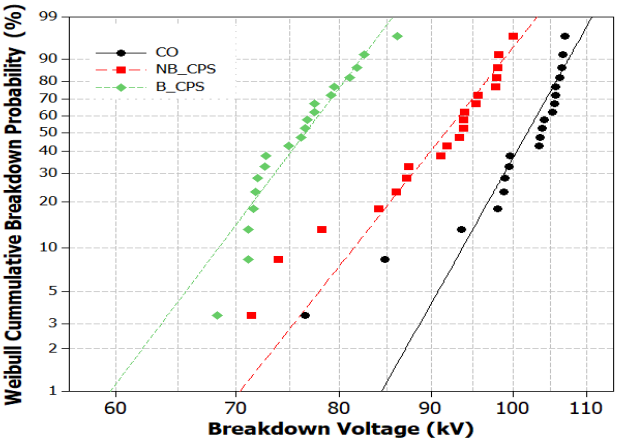

Figure 1: Weibull distribution plot for the Clean Oil, Contaminated and Bridging influence to the breakdown strength

Table 1. Weibull parameters of breakdown results for the Clean Oil, Contaminated and Bridging

Parameter	B_CPS	NB_CPS	CO
Moisture Content (ppm)	7.67		6.08
Mean LIBV (kV)	76.03	90.47	100.68
50% Breakdown Voltage (kV)	77.82	91.97	102.01
Shape Parameter (α)	16.85	16.01	22.61
Scale Parameter (β)	78.24	93.80	103.35

CONCLUSIONS

As a conclusion, the fiber dust and bridge formed in the oil, absolutely reduced the dielectric strength of the oil. The contaminated oil slightly alters the oil features from insulative to conductive behavior, thus, reducing the insulation performance of the oil.

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TREE INCEPTION VOLTAGE IN XLPE CONTAINING ALUMINA NANOFILLER

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Abstract – Currently, XLPE is widely used in underground high voltage cable. Recently, a few nanofillers have been selected by numerous researchers to enhance the electrical tree resistance in polymer matrix. In this paper, the influence Al_2O_3 nanofillers on the tree inception voltage (TIV) in XLPE have been investigated. The concentration of nanofillers loading are varies from 0.5 wt%, 1 wt% and 1.5 wt%. The needle-plane electrodes are used in this investigation and the gap between the electrodes is 2 mm.. The results show that the XLPE containing 1wt% Al_2O_3 has higher tree inception voltage (TIV) compared with unfilled XLPE.

INTRODUCTION

The presence of nanofillers in polymer matrix has been paid much attention as polymer nanocomposites have possibility to improve the mechanical properties such as tensile strength, toughness, bending strength and greater heat and chemical resistance [1-3]. Furthermore, it also has capability to improve the electrical properties such resistance to the electrical tree and breakdown phenomenon [4]. Therefore, in this paper, the investigation on the characteristics of electrical tree of XLPE containing various concentrations of Al_2O_3 nanofiller has been performed. The concentrations of Al_2O_3 nanofiller in XLPE were varied from 0.5wt% ,1 wt% and 1.5 wt%. The result of electrical tree characteristics for XLPE/Al_2O_3 nanocomposite were compared with the unfilled XLPE.

METHODOLOGY

The XLPE containing with Al_2O_3 nanofillers was prepared in the form of rectangular-shaped test sample. The size of the sample was 15mm x 25mm x 2mm, respectively. The needle-plane electrodes geometry were used in the experiments. The tungsten needle electrode of 1mm diameter with the tip radius 5±1 μm and tip angle 30° was inserted slowly into each test sample. Aluminum tape was used as a plane electrode and the gap of needle-plane electrodes is 2±2 mm.

RESULTS AND DISCUSSION

The result of (TIV) with respect to filler concentration of Al_2O_3 nanofillers in XLPE is shown in Fig. 1. The result shows that the TIV for Al_2O_3 nanofillers are increased with the filler concentration up to 1wt%. The TIV start to decrease as the filler concentration exceeded 1wt% but still higher than unfilled XLPE. The addition of 1 wt% Al_2O_3 nanofiller in XLPE may reduce the interparticles distance in nanocomposite. According to the dual model, a tightly bound region of nano particles will be achieved with optimal existence of filler (reduction of interparticles distance) in XLPE nanocomposites without agglomeration. The homogeneous dispersion of filler causes the TIV increases as the concentration of the filler increased up to 1 wt% [5].

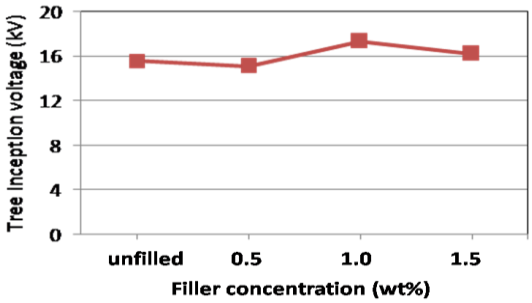

Fig. 1. Variation in tree inception voltage with respect to filler concentration in XLPE with Al_2O_3 nanofillers

CONCLUSIONS

The effect of Al_2O_3 nanofiller in XLPE on TIV has been investigated. It can be concluded that the addition of 1 wt% of Al_2O_3 nanofiller in XLPE had improved the TIV of the nanocomposite. The TIV for 1.0wt% and 1.5wt% Al_2O_3 nanofiller in XLPE are 9.56% and 3.2% higher than the unfilled XLPE.

ACKNOWLEDGEMENTS

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WIRELESS SF6 GAS DISTRIBUTION MONITORING SYSTEM

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Abstract – This paper presents the preliminary study on the behavior of SF_6 gas in the gas mixture by developing a gas monitoring system. The monitoring system consists of SF_6 gas sensor, Arduino Uno microcontroller and radio frequency module to monitor wirelessly the distribution of SF_6 gas mixed with N_2 in the high voltage test vessel. The results showed that the SF_6 gas concentration varies over time, suggesting there is a need to examine the homogeneity of mixed gases in the research of alternative insulating gas for SF_6 before any high voltage test is done.

Keywords – Gas insulation, SF_6 gas mixtures, SF_6 gas sensor

INTRODUCTION

Enormous efforts have been carried out by researchers to find the alternative of SF_6 gas for high voltage switchgear, including SF_6/N_2 gas mixtures [1]. However, the distribution of these gases in a gas vessel is not clear. Typically, the gas mixture is left for a few hours with assumption it will fairly distributed in the vessel before any high voltage test is performed. Hence, this project develops a wireless monitoring system to investigate the distribution of the gas mixtures by monitoring the concentration of SF_6 gas over a certain period of time.

METHODOLOGY

Figure 1 shows the process flow of the gas monitoring system. It consists of SF_6 gas sensors that are placed at the top and bottom of gas vessel and the data will be stored on the laptop. In order to study the homogeneity of gas mixtures, SF_6/N_6 gas mixture was used. In this work, the gas insertion sequence is as follows: the SF_6 gas was inserted first, then followed by N_2.

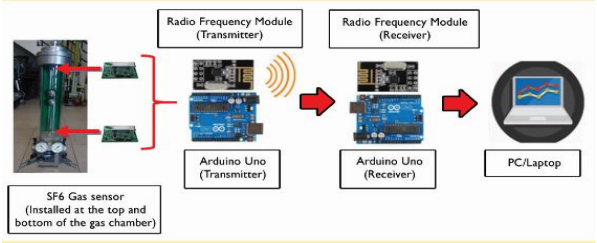

Figure 1: Process flow of the gas monitoring system.

RESULTS AND DISCUSSION

Figure 2 shows the voltage levels measured from the SF_6 gas sensor representing the concentration of SF_6 gas when mixed with N_2. To note, the sensor is characterized with output voltage from 0.4 V to 2.0 V, to represent the SF_6 gas concentration from 0 ppm to 1000 ppm. Based on the figure, as SF_6 gas in inserted, there is a sharp rise in the SF_6 measured by the sensor placed at the bottom. This shows that the SF_6 gas is immediately detected by the sensor due to the movement of gas particle that spread out to fill the vessel. Then, the insertion of N_2 gas about 5 minutes later has caused a sudden drop in the SF_6 concentration at the bottom of the vessel. This shows that some of N_2 particle has immediately replaced the SF_6 particle. Then, the replacement process starts to slow down, in which this perhaps due to the significant difference in the molecular weight between SF_6 and N_2 gases. To note, the density of SF_6 gas is 6.139 g/l, whilst N_2 is 1.165 g/liter.

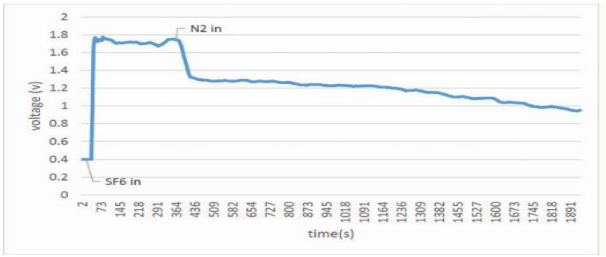

Figure 2: SF_6 gas concentration measured by sensor at the bottom of the gas vessel.

CONCLUSIONS

In conclusion, a wireless monitoring system that is able to monitor the concentration of SF_6 gas has been developed. Preliminary experimental work has been undertaken to investigate the homogeneity of gas distribution in SF_6/N_2 mixture. The results suggest that there is a need to monitor the SF_6 gas concentration in the research of alternative insulating gas for SF_6 before any high voltage test is conducted to obtain a valid data of gas mixture.

ACKNOWLEDGEMENTS

The authors wish to thank Ministry of Education (MOE) Malaysia and Universiti Teknikal Malaysia Melaka (UTeM) for funding this study. This work is funded under Fundamental Research Grant Scheme (FRGS/1/2016/TK04/FKE-CERIA/F00304). An appreciation also goes to Indkom Engineering Sdn. Bhd. for providing certain research materials throughout this study.

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ANALYSIS OF NATURAL ESTER TRANSFORMER OIL UNDER THERMAL AGING CONDITIONS USING UV-VIS SPECTROSCOPY

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Abstract – This paper aims to investigate the relationship between thermal aging conditions of natural ester transformer oil (rapeseed) and Ultraviolet-Visible (UV-Vis) spectra. UV-Vis spectrophotometer was used to measure the absorbance of incident light on different degrees of aging oil samples. The results show that the light absorbed by the samples increases as the aging duration increases. However, there is no significant difference between samples that thermally aged for 100 hours and 250 hours.

Keywords – Natural ester oil, UV-Vis spectra, thermal aging

INTRODUCTION

Nowadays, ester oils are increasingly accepted as alternative insulating liquids to mineral oils for high voltage transformers. While research to further improve their performance has become recent interest [1], it is also necessary to investigate their characteristics for condition monitoring purposes. Hence, this paper presents the preliminary study on the relationship between thermal aging conditions of rapeseed oil based natural ester transformer fluid and UV-Vis spectra.

METHODOLOGY

In this work, rapeseed-based transformer oils were prepared by thermally aging the oils in vacuum oven at 130°C. Metal substances which are Copper (Cu), Zinc (Zn), Aluminum (Al) and Iron (Fe) were added into the oils to enhance the aging process. Four different degrees of aging according to aging durations i.e. 100 hours, 250 hours, 1000 hours and 1500 hours, labelled with S2, S3, S4 and S5 respectively were set. Meanwhile, one fresh and clean oil labelled with S1 was used as a benchmark. Eventually, the optical spectra for each sample was measured by using UV-Vis spectrophotometer in accordance with ASTM D6802.

RESULTS AND DISCUSSION

Figure 1 shows the UV-Vis spectra of absorbance against wavelength for range between 380 nm to 600 nm. Generally, the lower the wavelength, the higher absorption of electromagnetic spectrum by the oil samples. Meanwhile, as the aging duration increases, light absorbed by the samples increases. This is due to the logarithmic relation whereby the transmittance of light decreases as the concentrations of absorbents increase. To note, the color of the oil will become darker when it is aged as a result of oxidation process. However, no significant difference is observed between samples that thermally aged for 100 hours and 250 hours, suggesting sufficient aging period is required to observe the difference. It is worthwhile noting that, there are negative values of the absorbance, indicating the intensity of light passing through the sample is greater than the intensity of light passing through the reference.

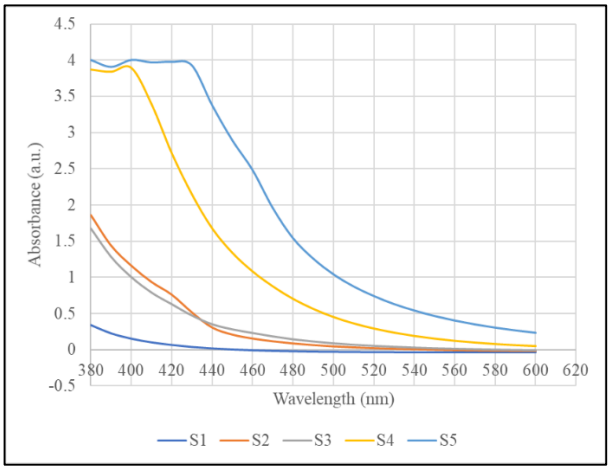

Figure 1: Absorbance against wavelength

CONCLUSIONS

Preliminary analysis on the relationship between thermal aging conditions of rapeseed oil based natural ester transformer fluid and UV-Vis spectra has been undertaken. There is a good correlation between the aging period of rapeseed-based natural ester oil and the UV-Vis spectra of light absorbance. However, sufficient aging period is required to clearly differentiate the performance of each sample.

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RELATIONSHIP BETWEEN REFRACTIVE INDEX AND TOTAL ACID NUMBER AND WATER LEVEL IN THERMALLY AGED NATURAL ESTER TRANSFORMER OIL

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Abstract – This paper presents the relationship between the refractive index (RI) of thermally aged rapeseed oil based natural ester fluid and two common dielectric properties of insulating fluid, which are the average total acid number (TAN) and moisture content. Different thermally aged oil samples based on aging period were prepared for analysis purpose. The RI values were measured using a digital refractometer, whilst the TAN and water contents were measured in accordance with ASTM D974 and ASTM D1533 correspondingly. The results show that, to certain extent the RI has significant correlation with TAN, whilst there is no correlation between RI and water content.

Keywords – Natural ester oil, refractive index, total acid number, water content

INTRODUCTION

At present, several diagnostic techniques have been applied to transformer condition monitoring. However, utility companies are still looking for more cost effective methods that can reliably monitor their equipment. This has led numerous attempts by researchers to develop precise and low-cost sensors for detecting faults and aging in high-voltage transformers. One of the efforts is using refractive index to monitor the quality of mineral oil in high voltage transformers [1]. This paper, on the other hand, presents the relationship between the refractive index (RI) and two common dielectric properties of insulating fluid, which are the average total acid number (TAN) and moisture content for thermally aged natural ester transformer oil.

METHODOLOGY

In this work, rapeseed-based transformer oil was used as the oil samples. The oils were thermally aged in vacuum oven at 130°C along with metals that are usually used in transformer parts, i.e. Copper (Cu), Zinc (Zn), Aluminum (Al) and Iron (Fe). Four different degrees of aging were set according to aging durations i.e. 100 hours, 250 hours, 1000 hours and 1500 hours. These samples are labelled with S2, S3, S4 and S5 respectively. Meanwhile, one fresh and clean oil labelled with S1 was used as a reference. The TAN and water contents in the oil samples were measured in accordance with ASTM D974 and ASTM D1533 correspondingly. Meanwhile, the RI of the oil samples were measured by using the digital refractometer. It is worthwhile noting that the RI increases with ageing period.

RESULTS AND DISCUSSION

Figure 1 shows the relationship between the RI and two insulation properties of the oil samples, i.e. TAN and moisture contents. In general, the RI increases as TAN is increased. There is a significant increase in the RI until the TAN in the oil sample reaches a knee point at about 6 mgKOH/g. Then, there is no obvious change in the RI as the TAN is further increased, indicating RI cannot give good indication of aging due to excessive formation of acids the rapeseed-based transformer oil. On the other hand, it is obvious that there is no significant correlation between the RI and water contents.

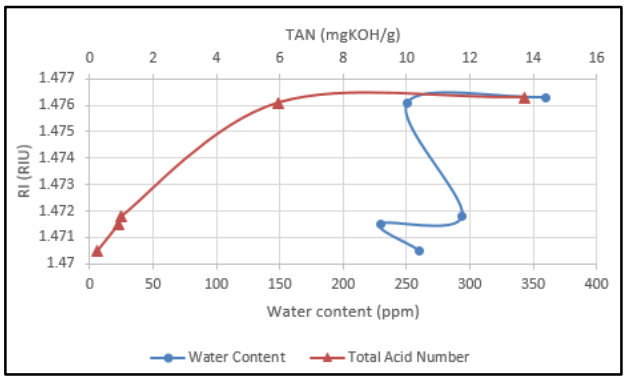

Figure 1: Refractive index against total acid number and water content

CONCLUSIONS

In conclusion, the relationships between RI and two common insulating properties of transformer oil, i.e. TAN and water content have been investigated. Correlating the RI with TAN perhaps possible at the early stage of aging. However, the presence of water cannot be detected using RI.

ACKNOWLEDGEMENTS

The authors would like to thank Universiti Teknikal Malaysia Melaka (UTeM) for funding this work. This work is funded under UTeM Short Term Research Grant Scheme (PJP/2019/FKE(4C)/S01669).

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FAULT CLASSIFICATION IN TRANSMISSION LINES USING ANN.

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Abstract **–** In power systems, faults can happen and the supply to the users are interrupted and this could effects by damaging the load as it can cause high current (I) flow. Transmission line used in this research is 138kV and 230kV. In this project, a study about the lines after the fault happened such as the magnitude of the voltage (V) and current at ground (Ig). After that, an analysis of the types of fault in transmission lines is going to be classified by using Artificial Neural Network (ANN). The feed-forward neural network is used to analyze the type of fault in this study. At the end of this project, the type of fault are able to be recognize and classified by 100% accuracy at 3 hidden layer.

Keywords – fault, classified, Artificial Neural Network (ANN), transmission lines

INTRODUCTION

Faults is an abnormal V or I reading that occurs in transmission lines. Most of the faults in power systems happened in transmission line since it is exposed to the atmosphere [1]. There are four faults that happens in power system which is three-phase (3-ø), single-line to ground (SLG), line-to-line (LL), and double-line to ground (DLG) faults. These faults can cause severe damage to the systems. Whenever faults happens, the effected lines or phase V will be zero or almost no reading and there will be an excessive I readings as there is no load connected that break by the protection systems. This study is to classify the types of faults that occurs in transmission lines. In order to solve this, the ANN [2] coding for fault classification by pattern recognition is develop. The application of "nntraintool" in feed-forward neural network used to get the best result and used for the analysis of this fault study, the problem in classifying fault in power system can be solved.

METHODOLOGY

A 24-bus of transmission line power system used in this study. It is a transmission network consist of 24-bus locations connected by 38 lines and four transformers. Newton Raphson method used to study the magnitude of V and Ig by using MATLAB. After the data of V and Ig is observed, the input data is intrepreted into binary number. For the faulted phase, the V will be '0' and if the phase is not faulted, V will be '1'. As for Ig, if there is reading of I, the condition set is '1' while if there is no reading, the condition set is '0'. There are 16 possibilities of condition that might happens. So the input data is varied for 16x38. For target data, there are five outputs which includes the four types of fault and also normal condition also uses binary code [1]. The input dataset and output dataset are loaded into the programming of ANN of 'network pattern recognition tool' or 'nprtool'.

RESULTS AND DISCUSSION

The data set trained by using the "nntraintool" and the best result obtain with an accuracy of 100%. The best validation performance is at 9.3116e-07 at epoch 102 which shows better result compared to the system that had only 1 hidden layer. As mention before, the validation performance for 3 hidden layer is much better as the epoch value obtain is much greater than the result at 1 hidden layer. Start the hidden layer with a small amount of hidden layer can be good as if the ANN architecture cannot learn the problem, increase the hidden layer [3]. As for this study, the hidden layer is set for various amount but the best result is at 3 hidden layer.

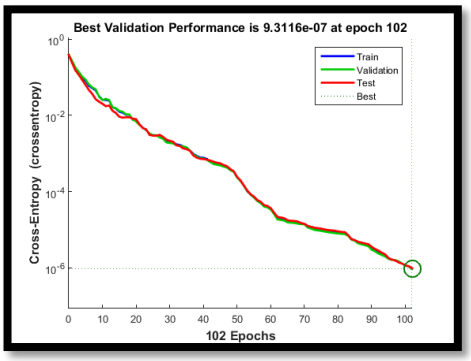

Figure 1: Validation Performance Graph.

CONCLUSIONS

The results obtain assure that the objectives of this study is achieved. The system can classify the faults that occurs in power system based on the pattern set in the input and targeted data. The types of fault can also be validate by the ANN as the V is set according to its phase on every line and Ig is stated in the input for its present and absent. However, the faults might be misclassified due to certain factor such as the data for output is not following the binary rules of 2^x. As for future recommendation, the researcher can improve this study by using different method of ANN.

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A STUDY ON HEAT TRANSFER DISTRIBUTION OF DIFFERENT LENGTH OF GROUNDING ELECTRODE

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Abstract **–**In this paper, the heat transfer distribution was studied in terms of different lengths of the rod electrode. To maintain the grounding system efficiency, it is necessary to deviate energy and heat to the ground. The Finite Element Method (FEM) are used to compare the heat transfer distribution of these different lengths of rod electrode. Modeling and simulation of the grounding system are in 3 Dimension (3D) by using COMSOL Multiphysics software. The result show the longer rod electrode produce the efficient grounding electrode in grounding system.

Keywords- heat transfer, electrode, FEM, COMSOl

INTRODUCTION

Grounding is known as the process of metal objects electrically connected to earth through a system of earth electrodes to reduce risk of electric shock. Having a low value of resistance can limit potential ground surface differences when the occurrence of fault current. The National Electric Code (NEC) requires the grounding electrodes to be tested to ensure that the electrodes are below 25 ohms of ground resistance (Earth) [1]. In other hand, the electrode must have high electricity conducting properties which can allow the huge amount of current to flow in low resistance condition.

METHODOLOGY

In this project, the simulation of heat transfer distribution of electrode grounding is by using the FEM software package which is COMSOL Multiphysics. FEM is the best method for observe the heat transfer distribution and provides more reliable results than basic engineering formulas[2]. The variety input set up which is rod grounding electrode with different lengths are used to observe the heat transfer on grounding system.

RESULTS AND DISCUSSION

Fig.1 depicts the result for heat transfer of rod grounding electrode with particular length of electrode which are 1.5 m, 2.5 m and 3.5 m. Temperature value for 1.5 m is represented by blue colour, while red colour represents 2.5 m and the green colour represents for 3.5 m.

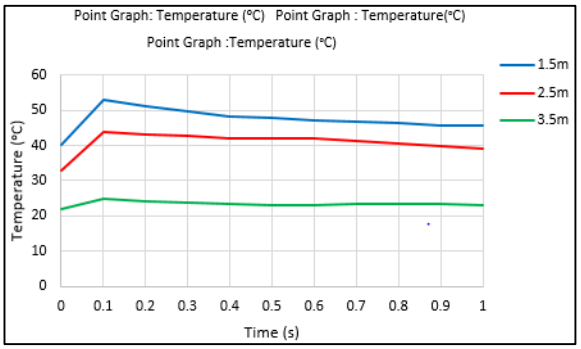

Fig. 1: Temperature of surrounding soil with different length of rod electrode.

The temperature distributed to the soil was rapidly increased at time between 0 second and 0.1 second. After that, the temperature was slowly decreased until 1 second. The maximum temperature is dispersed by 1.5 m length of rod electrode which is 53°C. It was the highest temperature dispersed to the soil among three different length of copper electrode. While, 2.5 m dispersed second highest maximum temperature which is 44°C and the lowest of all is 25°C devoted by 3.5 m.

CONCLUSIONS

According to the result gained, the heat transfer distribution of grounding system with different types of electrode, length and width of electrode was successfully analysed in COMSOL Multhiphysics software. The result indicate that the used of longer rod electrode will lower the value of resistance in electrode. Thus, current can easily flow through the electrode and heat distributed in short time.

ACKNOWLEDGEMENTS

The author would like to thank Faculty of Electrical Engineering, Universiti Teknologi Mara Pulau Pinang (UiTM) and Centre of study of Electrical and Electronic Engineering Universiti Sains Malaysia (USM) for the support on this project.

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AN EXPERIMENTAL STUDY ON ULTRAVIOLET SENSOR SIGNAL PATTERN OF DIFFERENT TYPES OF INSULATOR MATERIAL

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Abstract **–** **M**easurements on the ultraviolet signals emitted during insulators surface discharges have shown to be a good method to detect surface discharge from insulator transmission line. Laboratory investigations were carried out where UVTRON R2868 Flame Sensor was used to detect the ultraviolet signal emitted from insulator during discharge activities from glass and ceramic type of pin insulators. Various discharge intensities were generated in order to study the correlation between the ultraviolet signals of various discharge level with type of insulator material. At the end of study, the result shows that flame sensor could detect the ultraviolet pulse emitted from both type of pin insulators. This study illustrates that ultraviolet pulse method using flame sensor is a potential tool to monitor the insulator surface condition during service

Keywords – UVTRON Flame Sensor, Ultraviolet Pulse, Insulator Surface Condition

INTRODUCTION

The reliable and uninterrupted operation in power system depends on reliable insulation [1]. From time to time, defective insulators have been found on transmission lines which lead to flashover during service [2]. There are so many causes that can trigger the surface discharge and almost all of them will eventually lead to flashover and breakdown in the transmission line system. Early detection can help in preventing such damage from developing into a disruptive fault [3]. There has been increasing interest in recent years in implementing measurement on the ultraviolet signals emitted during insulators surface discharge from insulator. Ultraviolet radiation is periodically emitted during the discharges. The wavelength ranges from 10nm to 400nm. This study aims to detect and measure the ultraviolet signals during UV emission due to discharge activities on the surface of insulators

METHODOLOGY

This study was carried out in High Voltage Laboratory. Generally, the experimental setup consists of test chamber, high voltage transformer, UVTRON R2868 flame sensor, Picoscope and computer. The UVTRON R2868 was used together with its driving circuit manufactured by Hamamatsu Company. It detected the ultraviolet radiation emitted during discharge activities. The output of the sensor was connected to computer via Picoscope. The signal data were saved in Picoscope files before being transferred into Microsoft Excel for further analysis.The insulator samples used were glass and ceramic pin insulators that were naturally aged while in service.

RESULTS AND DISCUSSION

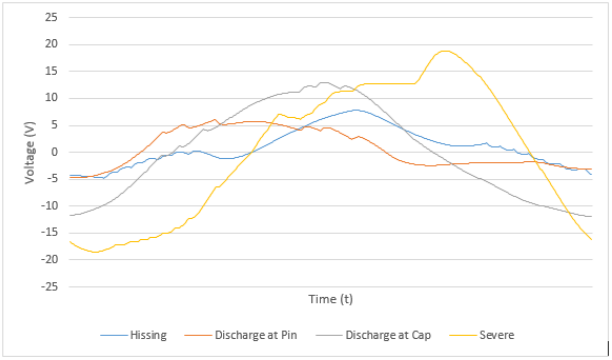

Fig. 1 Ultraviolet signal for glass insulator

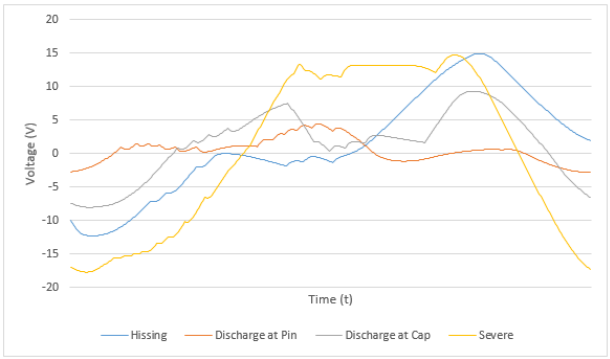

Fig. 2 Ultraviolet signal for ceramic insulator

CONCLUSIONS

Based on experimental results, correlation between components of the ultraviolet signals and discharge intensity levels under different insulator materials is exists using the ultraviolet pulse detection method. This proved that flame sensor is a potential tool in near future when applying UV pulse method

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OPTIMIZATION OF CORONA RING DESIGN FOR PORCELAIN INSULATOR STRING

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Abstract **–** Design of optimum corona ring dimensions on a porcelain insulator string was obtained in this work. From the relationship between the corona ring dimensions and the electric field magnitude, a non-linear mathematical objective function was established. The objective function was used in Imperialist Competitive Algorithm (ICA) to obtain the optimum design of corona ring on the insulator string. The results were compared with Genetic Algorithm (GA) and Particles Swarm Optimization (PSO).

Keywords – Insulators, Corona Ring, Optimization, Finite element analysis

INTRODUCTION

Insulator strings support the high voltage conductor and insulate the conductor from the ground. Due to the high electric field between the conductor and air surrounding the conductor, corona discharges can occur and cause degradation of the insulator string. Installing a corona ring on the insulator string can reduce the electric field along the insulator string [1]. However, to reduce the electric field significantly, an optimized design of corona ring needs to be obtained.

METHODOLOGY

Figure 1 shows the model geometry of insulator string with corona ring that was developed using finite element analysis software [2]. The corona ring tube radius, corona ring radius and the position of the corona ring along the insulator string were varied by the optimization methods, which include ICA, GA and PSO.

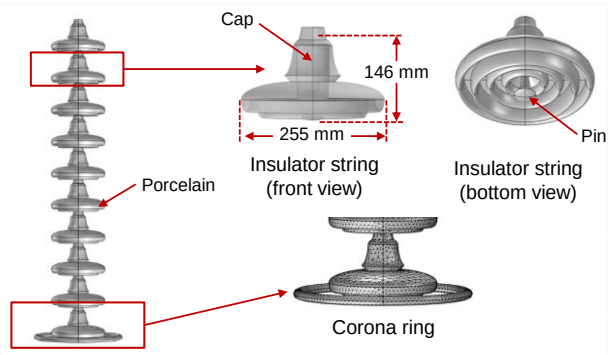
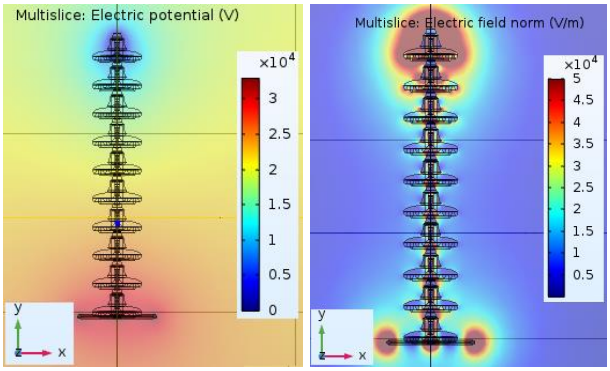


Figure 1: Project methodology

RESULTS AND DISCUSSION

Figure 2 shows the electric potential and field distribution on the insulator string with corona ring geometry under 33kV applied voltage. Table 2 shows the corona ring dimensions and the electric field magnitude on the insulator string obtained using different optimization techniques.



(a) (b)

Figure 2. (a) Electric potential and (b) electric field distribution on the model geometry

Table 1: Results obtained using different optimization techniques

Optimization method	Ring radius (m)	Tube radius (m)	Ring position (m)	Electric field magnitude (x10^4 V/m)
Unoptimized	0.29	0.018	0.20	4.05
ICA	0.33	0.013	0.48	3.20
GA	0.35	0.014	0.43	3.76
PSO	0.33	0.015	0.40	3.46

CONCLUSIONS

The electric field near the high voltage terminal of the insulator string strongly depends on the corona ring radius, tube radius and the position of the corona ring along the insulator string. ICA yields lower electric field magnitude on the insulator string compared to PSO and GA. Thus, using optimization methods, it can assist manufacturers in designing optimum dimensions of corona ring to reduce the electric field magnitude along the insulator string surface.

ACKNOWLEDGEMENTS

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MODELLING OF THREE-PHASE VOLTAGE SOURCE INVERTER (VSI) FOR GRID-CONNECTED PHOTOVOLTAIC (PV) GENERATION SYSTEMS

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Abstract – The photovoltaic (PV) system becomes a focal interest nowadays as one of promising renewable energy to be integrated with the utility grid. The voltage magnitude, line frequency, phase angle as well as phase sequence are vital synchronization parameters for effective power-transfer mechanism between the PV system and the grid. DC-DC boost converter incorporates with three-phase inverter works as intermediate. Based on the result, it clearly shows that the proposed system able to achieve IEEE grid-code standards and requirements.

Keywords - Photovoltaic, Three-phase inverter, Synchronization

INTRODUCTION

Recently, the photovoltaic (PV) systems play a significant role as an alternative electrical supply source as well as an integral part of the national grid generation [1]. The grid-connected PV generation system poses some notable challenges to researchers. The increasing penetrations level of PV systems into the utility grid have risen several potential problems relating to power quality together with safety issues. Due to these concerns, IEEE standard 929-2000 which intends for the utility interface of PV systems becomes a reference source for energy producers in integrating PV systems with the utility grid [2]. This paper presents the modeling of the three-phase voltage source inverter (VSI) for a grid-connected photovoltaic (PV) generation system focusing solely on the level of total harmonic distortion (THD) of the generated signal waveforms.

METHODOLOGY

The proposed system consists of several PV modules, DC-DC boost converter together with maximum power tracking technique (MPPT), three-phase voltage-source inverter (VSI), filtering system and the utility grid [3]. The components configuration is illustrated in Figure 1.

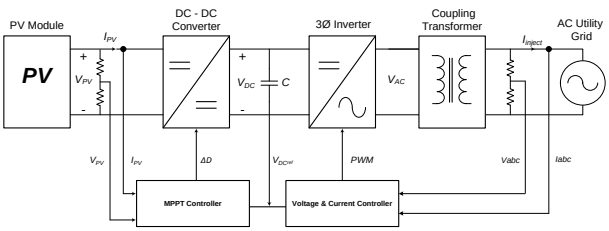

Figure 1: Three-phase grid-connected PV generation systems.

A PV module is made up of multiple connections of PV cells in series and parallel configurations. By referring to equation (1), the magnitude of DC-DC Boost converter's output voltage can be calculated as follows,

$$V_O = \frac{V_I}{1-D} \tag{1}$$

where V_O, V_I and D are DC-DC boost input voltage, output voltage and value of duty cycle respectively [4]. Meanwhile, the RMS line voltage of the three-phase inverter is given by equation (2),

$$V_L = m\frac{\sqrt{3}}{2\sqrt{2}}V_O \tag{2}$$

where m is the modulation index and V_L is the RMS value of line voltage for three-phase voltage source inverter (VSI). The introduction of a step-up coupling transformer in a grid-connected PV generation system is to power-up the line voltage level according to grid standard and also to works as galvanic isolation between the PV system and the utility grid [5]. Equation (3) shows the relationship between the primary, V_P and secondary, V_S voltage windings of the three-phase wye-delta ($Y-\Delta$) coupling transformer [6].

$$\frac{V_P}{V_S} = \frac{1}{\sqrt{3}} \tag{3}$$

RESULTS AND DISCUSSION

Based on the calculated value as in the previous section, the simulation of the designed models is carried out in Matlab/Simulink environments version R2014a. In this model, sinusoidal pulse width modulation (SPWM) is implemented as modulation control technique for the three-phase VSI. The detailed specifications and list of parameters of the proposed model are given in Table 1.

Table 1: List of Parameters

Parameter	Value
Input PV Supply, $V_{i\,dc}$	$180V_{dc}$
Switching frequency, f_s	$10kHz$
Coupling Transformer	$240V_{LL}/415V_{LL}$
Passive Filter	$L = 90mH$ & $C = 14uF$
Line Voltage, V_L	$415V_{LL}$
Line Frequency, f_L	$50Hz$

The simulation result shown in Fig. 2 is the three-

phase line voltage waveform of the VSI inverter. The voltage waveforms are purely sinusoidal, separated by 120º degree between each phase. The RMS value each of the line voltage waveform is 415V and the operating line frequency is 50Hz. One of the main criteria for grid synchronization is to have low total harmonic distortion (THD) both for voltage and current waveforms.

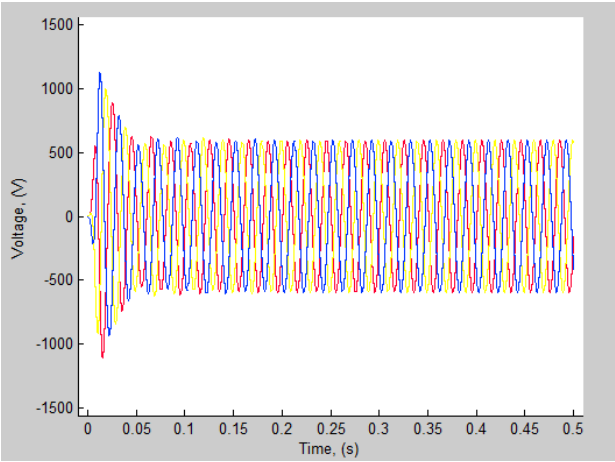

Fig. 2 Line voltage waveform of the three-phase VSI.

As displayed in Fig. 3 and Fig. 4 respectively, the total harmonic distortion (THD) for line voltage waveform is around 0.48% whereas the total harmonic distortion (THD) for line current waveform is approximately 0.49% which is less than 5% of the fundamental frequency at the rated inverter output as required by IEEE Std 929-2000. It clearly proved that the proposed system able to achieve the IEEE grid-code standards and requirements.

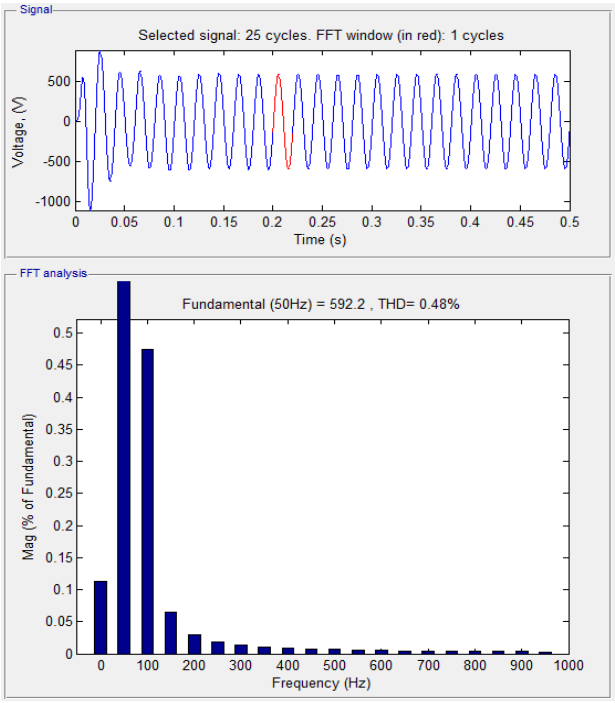

Fig. 3 THD for line voltage waveform.

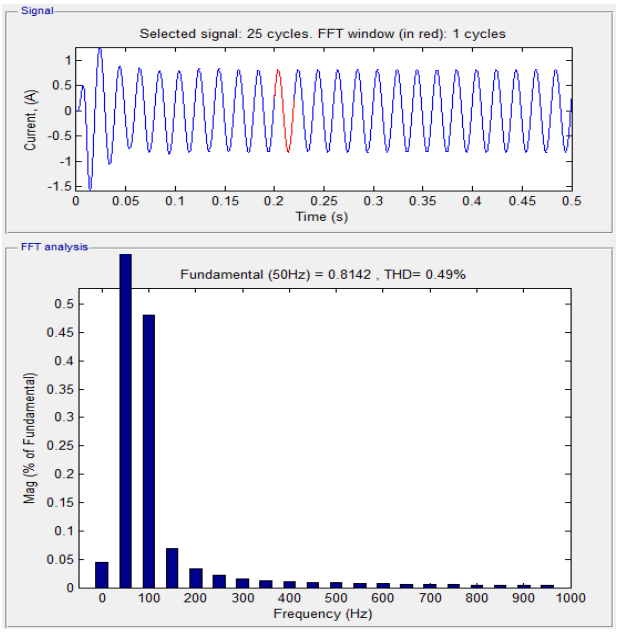

Fig. 4 THD for line current waveform.

CONCLUSIONS

Based on the result, it clearly shows that the proposed model system is able to generate a symmetrical three-phase ac line voltage of 415V with 50Hz operating line frequency. In addition, the total harmonic distortion (THD) for both voltage and current waveforms has complied with the IEEE standards which is less than 5% of the fundamental frequency at the rated inverter output. Therefore, the proposed model system is well-suited for a grid-connected PV generation system.

ACKNOWLEDGEMENTS

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OPTIMAL PLACEMENT OF PMU FOR COMPLETE OBSERVABILITY OF POWER SYSTEM CONSIDERING ZERO INJECTION AND ISLANDING CONDITION

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***Abstract*:** This paper presents the methodology for Optimal Placement of Phasor measurement unit (OPP) using Binary Linear Integer Programming (BLIP) with binary decision variables (0, 1) for minimizing the cost of installation to provide complete observability of the power system under normal and islanding condition. In this paper, the placement of PMU is realized with several cases namely conventional flow measurement, with zero injection and without zero injection. The best optimal location is one, a bus with maximum BOI, SORI and redundancy index. The results obtained using MATLAB have shown, the proffered method of PMU placement is fast and more accurate with excellent computational efficiency.

Keywords: Binary Linear Integer Programming (BLIP), Optimal Placement of PMU, Bus Observability Index (BOI).

INTRODUCTION

A Phasor Measurement Unit (PMU) is a most important power system tool which measures the time synchronized voltage and current phasor using a common synchronizing signal from global positioning system (GPS)[1]. Placing of PMU at every bus of a power system results in complete observability of the system but it increases the cost of installation. To overcome this problem, optimal placement of PMU (OPP) in a power grid gives the optimal cost of installation by reducing the number PMU in the grid [2]. The PMU prompted the utilities to locate the fault in system [2], state estimation [3] and system observability [4,5,6]. The binary integer linear programming approach was applied for placement and which uses the conventional flow measurement method [7]. In this paper the optimal placement of PMU is done using BLIP considering the cases of conventional power flow measurement, zero injection and islanding. The optimal placement of PMU by ranking the solution obtained using redundancy of the system.

BINARY LINEAR INTEGER PROGRAMMING (BLIP)

Binary Integer Linear Programming (BILP) is an optimization approach, in which all the variables are either 0 or 1. In power system network, the variable x_{ij} is representing the connection between any two buses (i and j are buses) and it is given in Eq. (1) as below,

$$x_{ij} = \begin{cases} 1, & \text{if } i = j \\ 1, & \text{if i and j are connected} \\ 0, & \text{otherwise.} \end{cases} \quad (1)$$

Considering the above assumptions, the objective function for placement of PMU in the power system network using binary decision variable and is represented using Eq. (2)

$$\min \sum_{K=1}^{N} X_K \quad (2)$$

where

Subject to:

$$T_{pmu} X_K \geq b_{pmu} \quad (3)$$

Where,

$$T_{pmu} = \begin{cases} 1 & \text{if PMU is placed at the bus} \\ 0 & \text{otherwise} \end{cases}$$

$$b_{pmu} = \begin{bmatrix} 1 \\ 1 \\ 1 \\ \vdots \\ 1 \end{bmatrix}_{NX1}$$

SOLUTION METHODS

The presented method of BILP is tested in IEEE 7 bus, 9 bus, 14bus and 30 bus system using Matlab software One of the test case system (IEEE-14 bus system) is analysed for various cases such as with and without conventional measurement, with and without zero injection for better clarity. The single diagram of IEEE - 14 bus system is shown in Fig.1

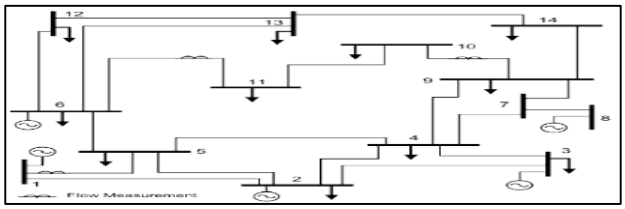

Figure.1 IEEE 14 Bus System

RESULTS AND DISCUSSIONS

In this paper binary integer programming has been used to solve the OPP problem. The Results for all the test systems with and without zero injections are shown in Table 1.

Table 1. Results for all the test systems with and without zero injections.

IEEE Test System	No. of Zero Injection Buses	No. of PMU's		CPU Time (s)		Non-Linear programming	
		With Zero Injection	Without Zero Injection	With Zero Injection	Without Zero Injection	No of PMU	CPU time
7BUS	1	2	2	0.025	0.024	-	-
9 BUS	3	3	3	0.031	0.012	-	-
14BUS	1	3	4	0.204	0.065	4	0.06
30BUS	6	7	10	0.984	0.432	10	0.110

Table 2. Simulation results for the test system with islanding

Power System	Optimal location of PMUs	Measurement Redundancy
IEEE 7 bus	2, 4	9
IEEE 9 Bus	4,7,9	12
IEEE 14 bus	2 ,6, 9	15
IEEE 30 bus	2, 4, 10, 12, 15, 18, 27	36

Table 3. Installation Cost With & Without Consider Zero Injection Buses.

Test systems (IEEE)	Without Zero Injection		With Zero Injection		Cost Reduction (%)
	No of PMU	Installation cost	No of PMU	Installation cost	
7BUS	2	$69411	2	$69411	0
9 BUS	3	$87205	3	$87205	0
14BUS	4	$105216	3	$87205	17.22
30BUS	10	$229933	7	$159466	30.64

CONCLUSION

This paper presents an OPP scheme for complete observability of the power system considering flow measurement, zero injection and islanding to avoid wide-area blackout following cascading failure of the system. The proffered method of OPP using binary linear integer programming is coded in Matlab R2015b software and tested in different IEEE buses. The results attained have shown that the bus with maximum BOI and redundancy index is the best optimal location for placement of PMUs with minimised cost of installation. The OPP with normal and control islanding case gives the global optimal solution with minimum number of PMUs.

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IMPROVEMENT OF WIND TURBINE LIGHTNING RECEPTOR

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Abstract – This project focuses on the study of lightning protection theory, knowledge and basis. Knowledge of cloud to ground lightning, lightning protection system (LPS), electric field relation, receptors configuration are elaborated. This project is aimed to study the practical parameters of LPS, including the relation between receptor size and electric field strength. Other than that, this project aimed to test three different diameters of receptors 0.2m, 0.5m and 0.8m with different needles numbers and lengths. This paper is aimed to develop a new shape of wind turbine receptors with different needles number and length also to suggest the parameters for receptor diameter and needles. Finite Element Method (FEM) has used for this research, the proper dimensions and shapes of receptors simulated by suggesting the minimum and maximum electric field that accumulates around receptors.

Keywords – Lightning Protection System (LPS), Electrical Field, Receptors.

INTRODUCTION

Wind energy (or wind power) refers to the process of creating electricity using the wind or air flows that occur naturally in the earth's atmosphere. Modern wind turbines are used to capture kinetic energy from the wind and generate electricity. Wind turbines rotate with 12mph speed and face strong wind and lightning [1]. Wind turbines can be exposed to the effects of lightning strikes due to their height and plain location such as their typical installation in mountains, off-shores and some other places. Therefore, these locations are more vulnerable to lightning [2].

Receptors varies as a major role in distributing voltage on wind turbine blades by different configuration. These receptors are connected to the ground (e.g. high voltage cables), which are installed in the blade through the hole onside blade sandwich directly to the earthing system. The latest studies have shown that the blades are still not protected, although there is a lightning receptor installed on both sides of the blade [3,4].

METHODOLOGY

Table 1: receptors parameters

Receptor size	0.2m			0.5m			0.8m		
Number of needles	16	24	32	16	24	32	16	24	32
Needles length	0.3m	0.3m	0.3m	0.6m	0.6m	0.6m	0.9m	0.9m	0.9m
	0.5m	0.5m	0.5m	0.7m	0.7m	0.7m			
	0.9m	0.9m	0.9m	0.9m	0.9m	0.9m			

This paper is evaluating the protection device shape and size to obtain the lightning strike methodology and the performance of receptors. Moreover, the fabrication of LPS using selected shape and size. The receptors with sharp needles are developed by different configurations that made on three receptor diameters 0.2m, 0.5m and 0.8m. These improvements took place in the number and length of needles shown in Table 1.

RESULTS AND DISCUSSION

The result of wind turbine lighting effect following the methodology stated. After computing different configurations of receptors, 0.2m receptor diameter with 32 number and 0.3m length of needle as shown in Figure 1. It can be observed that the electrical field strength around the receptor needles is high with the shortest needle length (0.3m) whereas the other two-length 0.5m and 0.9m have the lower field strength are plotted in Figure 2.

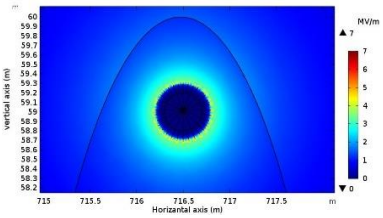

Figure 1: Electrical field simulation for 32 needles

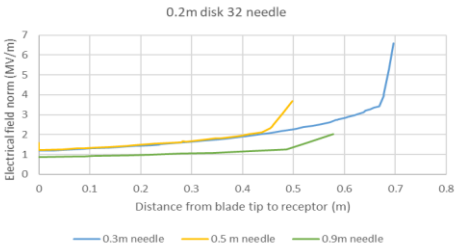

Figure 2: Electrical field plot graph for 32 needles

CONCLUSIONS

In conclusion, results show that receptor with 0.2m diameter provides higher protection efficiency than other sizes. Therefore is recommended for efficient lightning protection of modern wind turbines.

In 0.2m receptor diameter, the comparison between the numbers and length of needles presents that 32 number of needles and 0.3m length of needle can attract a higher electrical field than others.

ACKNOWLEDGEMENTS

First, I wish to express my gratitude to my project supervisor, Dr. Amir Izzani bin Mohamed. I also wish to thank my parents, wife and siblings.

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CLASSIFICATION OF CABLE JOINT DEFECTS USING OPTIMIZED ARTIFICIAL INTELLIGENCE

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Abstract **–** In this work, classification of cable joint defect types based on partial discharge (PD) data using optimized artificial intelligence was performed. After denoising the PD signals, feature extractions were performed from the signals. The artificial intelligence (AI) techniques used to classify the cable joint defect types include artificial neural network (ANN), support vector machine. (SVM) and adaptive neuro-fuzzy inference system (ANFIS). The performance of each AI performance was optimized using certain optimization techniques.

Keywords – Partial discharge, Cable joint, Artificial intelligence, Optimization

INTRODUCTION

In power cable joints, defect types can be recognized by PD measurement data because each PD type has its own unique characteristics. The existing technique to identify defect types is based on personnel experience. This can result in variation of the outcomes between different personnel. Hence, it is useful to develop a method or tool that can automatically classify the type of defect within power cable joint with high accuracy. Also, it can minimize the time and cost of repair, maintenance and diagnosis.

METHODOLOGY

The methodology of the work is shown in Figure 1. First, PD measurement was performed on four power cable joints with different defect types. The PD signals were denoised using discrete wavelet transformer (DWT) and wavelet packet transform (WPT). Feature extractions based on the signal parameters were performed from the denoised signals. The data were used to train and test ANN, SVM and ANFIS combined with optimization techniques, which are imperialist competitive algorithm (ICA), particle swarm optimization (PSO) and genetic algorithm (GA).

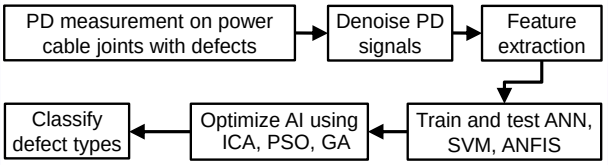

Figure 1: Project methodology

RESULTS AND DISCUSSION

The classification accuracy of every method that was tested is shown in Table 1. From this table, it can be seen that the classification accuracy is the highest for DWT-SVM-ICA (98.67%) compared to the other methods that have been tested in this work.

Table 1: Classification accuracy of the tested methods

Technique	Accuracy (%)
DWT-ANN	77.67
DWT-ANN-ICA	87.33
DWT-SVM	77.67
DWT-SVM-ICA	98.67
DWT-ANFIS	76.00
DWT-ANFIS-ICA	82.00
WPT-ANN	87.33
WPT-ANN-ICA	96.67
WPT-SVM	87.33
WPT-SVM-ICA	96.67
WPT-ANFIS	76.00
WPT-ANFIS-ICA	82.67
SVM-PCA [1]	85.00
ANN-PCA [1]	85.00
SVM with RBF [2]	94.05
ENN-fractal [3]	97.80

CONCLUSIONS

When the performance of SVM, ANN and ANFIS is optimized, the classification accuracy becomes higher than the unoptimized classifiers. SVM combined with ICA achieved higher classification accuracy compared to ANN and ANFIS. Thus, it can be recommended to industries that defect classification in underground power cable joints can be performed by hybrid artificial intelligence-optimization algorithm.

ACKNOWLEDGEMENTS

The authors thanked the Faculty of Engineering, University of Malaya for supporting this work through Faculty Research Grant (GPF077A-2018).

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High Voltage Calibration, Testing, Consultancy, Training, Research and Development at Institute of High Voltage and High Current, Universiti Teknologi Malaysia

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About MyHVnet

High voltage research and development activities continue to prosper in Malaysia due to rapid urbanisation across the country. Each year, an enormous amount of expenditure is allocated for the development of high voltage infrastructure and its relevant expertise to ensure its sustainability. This indirectly leads to an increasing number of players, both at the university and industry levels. While this certainly brings positive impact to the field of high voltage engineering, it can, sometimes, be difficult for interested parties to approach the right experts in a specific high voltage related area, e.g., lightning protection, condition monitoring and diagnosis, and insulation design. Consequently, more effective research and development activities related to high voltage engineering may have been hindered.

To address the above issue, the possibility of setting up an informal networking group relevant to high voltage engineering has been looked into. This leads to the idea of the establishment of Malaysian High Voltage Network (MyHVnet) in 2014. MyHVnet will hopefully serve as a "one-stop" platform for members from various organisations (universities and industries) across Malaysia for the effective communication of high voltage related research and development.

The main objectives of the establishment of MyHVnet are:

i) To serve as a platform for the discussion of high voltage related research and development among member organisations.

ii) To raise the awareness of the research and development capabilities of member organisations to high voltage related industries.

Photo session during 2019 MyHVnet's Annual General Meeting.

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