2021 3\textsuperscript{rd} International Conference on High Voltage Engineering and Power Systems (ICHVEPS)

October 5\textsuperscript{th} - 6\textsuperscript{th}, 2021
Bandung, Indonesia
- Virtual Conference -
On the day of the conference, should you have any inquiries, you could ask the secretariat staff at the secretariat virtual room. The secretariat virtual room can be accessed during the conference through the breakout room in the conference Zoom meetings named "Secretariat of ICHVEPS".
Distinguish participants and guests, welcome to The 3rd International Conference on High Voltage Engineering and Power System 2021 (ICHVEPS 2021). The conference will be held in Virtual Conference format on 5 and 6 October 2021. The ICHVEPS 2021 is a biannual conference organized by the School of Electrical Engineering and Informatics, Institut Teknologi Bandung (ITB), Indonesia and IEEE ITB Student Brand, with support of PT PLN (Persero), PT. Indonesia Comnets Plus, PT. LAPI and technically sponsored by IEEE Indonesia Section, Power and Energy Society Indonesia Chapter, and Indonesia Inter-University Forum on High Voltage Engineering. The conference is designed to be an international forum for exchanging ideas, discussing, and disseminating research results and technologies in High Voltage Engineering and Power System from power utilities, universities, research institutes, and industries. The conference received a large number of abstracts/papers submissions. After review, finally 127 papers from 18 countries (Indonesia, China, Ecuador, France, India, Iraq, Japan, Malaysia, Singapore, Sri Lanka, Thailand, Turkey, USA, Vietnam, Canada, New Zealand, Italy, dan Australia). The papers will be presented in 3 invited plenary sessions and 20 technical sessions. All accepted papers will be sent to IEEE Explorer (and Scopus), and selected papers will be published in International Journal on Electrical Engineering and Informatics.

Dr.Ir. Tutun Juhana, MT.
Dean of School of Electrical Engineering and Informatics,
Institut Teknologi Bandung
Dear participants, welcome to the 3rd International Conference on High Voltage Engineering and Power Systems 2021 (ICHVEPS 2021) which will be held in Bandung (Virtual Conference), The Capital of West Java, Indonesia 5-6 October 2021. This is a biannual conference organized by the School of Electrical Engineering and Informatics, Institut Teknologi Bandung, Indonesia and technically sponsored by IEEE Indonesia Section, Power and Energy Society Indonesia Chapter and IEEE ITB Student Branch and supported by Indonesia Electrical Power Company (PT. PLN Persero). The conference is designed to be an international forum for exchange ideas, discussion and dissemination of research results and technologies in the field of High Voltage Engineering and Power Systems. The previous conference (The 1st ICHVEPS 2017) was held in Bali October 2017 and The 2nd ICHVEPS 2019 was held also in Bali October 2019.

During this conference 127 papers from 18 countries will be presented in 3 invited plenary sessions and 20 parallel technical sessions. Invited lectures will be given by 15 prominent speakers such as Prof. Udaya Madawala from New Zealand, Prof. Masayuki Hikita from Japan, Prof. Guan-Jun Zhang from China, Prof. Abu Siada from Australia, Prof. Eduard Mulyadi from USA, Dr. MV Reddy from Canada, Prof. Andrea Cavallini from Italy, Prof. R. Sarathi from India, Prof. Gilbert Teyssedre from France, Prof. Norasage Pattanadech from Thailand, Prof. Pekik A. Dahono, Dr. Tumiran, Dr. Nanang Haryanto, Dr. Andreas, and Prof. Suwarno from Indonesia.

As the conference general chairman I would like to thank all international advisory and organizing committee members, all sponsors and supporters. I hope all participants in good health and can enjoy and benefit greatly from this conference. I also hope that the pandemic will end soon and we can hold this conference offline which enable us to meet face to face in the future.

Prof. Dr. Ir. Suwarno, MT., IPU
General Chairman of ICHVEPS 2021
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Secretariat</td>
<td>1</td>
</tr>
<tr>
<td>Welcoming Messages from Dean and Chairman</td>
<td>2</td>
</tr>
<tr>
<td>Table of Contents</td>
<td>4</td>
</tr>
<tr>
<td>Committee</td>
<td>5</td>
</tr>
<tr>
<td>General Information</td>
<td>7</td>
</tr>
<tr>
<td>Registration</td>
<td>10</td>
</tr>
<tr>
<td>Conference</td>
<td>11</td>
</tr>
<tr>
<td>Technical Instruction for Participant</td>
<td>13</td>
</tr>
<tr>
<td>Parallel Session Technical Instruction</td>
<td>16</td>
</tr>
<tr>
<td>Presentation Video Guidelines</td>
<td>18</td>
</tr>
<tr>
<td>Presentation Template</td>
<td>20</td>
</tr>
<tr>
<td>Rundown</td>
<td>21</td>
</tr>
<tr>
<td>Plenary Sessions</td>
<td>25</td>
</tr>
<tr>
<td>Parallel Technical Sessions</td>
<td>29</td>
</tr>
<tr>
<td>Abstract</td>
<td>70</td>
</tr>
<tr>
<td>List of Author</td>
<td>202</td>
</tr>
</tbody>
</table>
Organizing Committee

**General Chair:**
Suwarno (Institut Teknologi Bandung, Indonesia)

**General Secretary:**
Umar Khayam (Institut Teknologi Bandung, Indonesia)

**Treasurer:**
Fathin Saifur Rahman (ITB, Indonesia)

**Publications:**
Deny Hamdani (ITB, Indonesia)
Member:
Lunetta Safura (ITB, Indonesia)
Rahman Azis P. (ITB, Indonesia)

**Technical Program:**
Chair: Nanang Haryanto (ITB, Indonesia)
Member:
Bambang Anggoro (ITB, Indonesia)
Syarif Hidayat (ITB, Indonesia)
Sumaryadi (PT. PLN Persero)
Andreas (PT. PLN Persero)
Ariadi Hazmi (UNAND, Indonesia)
Waluyo (ITENAS, Indonesia)
Salama Manjang (UNHAS, Indonesia)
Sarjiya (UGM, Indonesia)

**Local Arrangement:**
Chair: Pradita O. H. (ITB, Indonesia)
Member:
Rizky Rahmani (ITB, Indonesia)
Bryan Denov (ITB, Indonesia)
Lenny Putri Yulianti (ITB, Indonesia)
Arpan Zaeni (ITB, Indonesia)
Jean Pierre Uwiringiyimana (ITB, Indonesia)
Farradita Nugraha (ITB, Indonesia)
Mistriana (ITB, Indonesia)
Adista Dwi Praharti (ITB, Indonesia)
Adit Firmansyah (ITB, Indonesia)
Fahmi Nurul Alimi (ITB, Indonesia)
Taufik Rhamdhani (ITB, Indonesia)
Ilham Muliawan (ITB, Indonesia)
Syadila Refiasto (ITB, Indonesia)
Ari Mukti (ITB, Indonesia)
International Advisory Committee:
Suwarno (ITB, Indonesia)
Bambang Anggoro (ITB, Indonesia)
Tumiran (Indonesia)
N. Sisworahardjo (USA)
M. Hikita (Japan)
B.W. Lee (South Korea)
Jaeho Choi (South Korea)
S Gubanski (Sweden)
A. Abu Siada (Australia)
Tian Hua Liu (Taiwan)
Peter Werle (Germany)
Syamsir Abduh (Indonesia)
Adi Soepriyanto (Indonesia)
Salama M. (Indonesia)

Y. Haroen (ITB, Indonesia)
Iwa Garniwa (Indonesia)
Z. Nawawi (UNSRI, Indonesia)
Sekers (Turkey)
Andrea Cavallini (Italy)
Takahashi (Japan)
Y. Mitani (Japan)
Kamarol (Malaysia)
Guan Jun Zhang (China)
Uwe Sichler (Austria)
Hozumi (Japan)
Sasongko P (Indonesia)
Evy Haryadi (Indonesia)
I.A.G. Antari (Indonesia)

The Master of Ceremony:
Kevin Marojahan Banjar Nahor (ITB, Indonesia)
Pradita Octoviandiningrum Hadi (ITB, Indonesia)
PAYMENT FOR CONFERENCE
There are three ways to pay for the conference, namely:
1. DOKU is the Technology-Based Payment System Provider service with integrated payment gateway, transfer services and collaborative commerce (e-wallet) services.
2. Paypal Whatever the business, PayPal is the solution with a Business account, you get access to a variety of features that can help run and grow your business.
3. Direct payment via account number

ABOUT BANDUNG
Bandung, City of Flowers, is the provincial capital of West Java and Indonesia’s third largest city, located about 180 km southeast of Jakarta. Known in colonial times as the Paris of Java because of its European ambiance and sophistication, Bandung shares with a fine legacy of Tropical Deco architecture dating from the 1920's. Situated on a mountainous high plateau in the beautiful Parahayangan mountains, Bandung’s pleasant climate and lush surroundings have offered an escape from the heat of the lowlands since the mid 19th century when it was the heart of the region’s most prosperous plantation area. Bandung is now a center of higher education, commerce and aircraft industry which despite its modern amenities still retains much of its colonial era charm.
ABOUT INSTITUT TEKNOLOGI BANDUNG

The history of engineering university in Indonesia dates back to the 20th century, when the Dutch colonial government established De Technische Hoogeschool te Bandung (THS) on July 3, 1920, on a 30-hectare plot of land in Bandung. At that time, there was only one faculty, de Faculteit van Technische Wetenschap and only one major, namely de afdeeling der We gen Waterbouw. The establishment of this engineering school was to fulfill the needs of technical personnel or engineers due to the outbreak of the First World War.

The first academic year of TH Bandung, 1920-1921, was unique because TH Bandung only got 28 students, and two of them are Indonesian. Meanwhile, there were 12 professors at the beginning of 1922. Four years later, on July 4, 1924, twelve students graduated from TH Bandung. TH Bandung was a Bijzondere School, which later changed its status as a state-owned campus.
ABOUT SCHOOL OF ELECTRICAL ENGINEERING AND INFORMATICS

Sekolah Teknik Elektro dan Informatika is a merger of the two historical department in ITB: Electrical Department that was established since 1947, and Informatics Department that was established since 1982.

Today, as the time passes by, STEI has developed into school with 6 Undergraduate Programs and 2 Master Programs, and 1 Doctoral Programs.

With the mission of becoming higher education institutions, developing education and knowledge of Electrical Engineering and Informatics Science that are superior and leading in Indonesia and are recognized in the world and playing an active role in advancing and prospering the nation, STEI is the place for you to get the best education in the field of Electrical Engineering and Informatics.

Twin Building STEI ITB
REGISTRATION

For further information please come to ICHVEPS2021 secretariat office.

Registration Fee
The registration fee includes conference proceedings admission to all sessions

Participants without paper submission could join the conference with the registration fee as stated below.

- IEEE Member: USD 200
- Non Member: USD 250
- Student: USD 150
- Local Participant: IDR 3,000,000
- Local Academia (lecturer/student): IDR 1,500,000
- Participant without paper submission: USD 100/IDR 1,500,000
The 1st International Conference on High Voltage Engineering and Power System 2017 (ICHVEPS 2017). The conference in Inna Grand Bali Beach Hotel Sanur Bali, Indonesia on 2-5 October 2017. The ICHVEPS 2017 is the first biannual conference organized by the School of Electrical Engineering and Informatics, Institut Teknologi Bandung (ITB), Indonesia with support of PT. PLN (Persero) and technically sponsored by IEEE Indonesia Section, Power and Energy Society Indonesia Chapter and Indonesia Inter-University Forum on High Voltage Engineering. The conference is designed to be an international forum for exchange ideas, discussion and dissemination of research results and technologies in the field of High Voltage Engineering and Power System from power utilities, universities, research institutes as well as industries. The conference received a large number of abstracts/papers submission. After review, finally 126 papers from 12 countries (Indonesia, Malaysia, India, Australia, China, Japan, Brunei Darussalam, France, Sweden, USA and Nigeria) were accepted. The papers were presented in 2 invited plenary sessions and 16 technical sessions.

The 2nd International Conference on High Voltage Engineering and Power System 2019 (ICHVEPS 2019). The conference in Inna Grand Bali Beach Hotel Sanur Bali, Indonesia on 1-4 October 2019. The ICHVEPS 2019 is a biannual conference organized by the School of Electrical Engineering and Informatics, Institut Teknologi Bandung (ITB), Indonesia and sponsored by IEEE Indonesia Section, IEEE Power and Energy Society Indonesia Chapter, IEEE Indonesia Student Branch and PT. PLN (Persero). The conference received a large number of abstracts/papers submission of more than 186. After review, finally 136 papers from 13 countries (Indonesia, Germany, Malaysia, India, Australia, South Korea, China, Japan, Vietnam, Canada, Italy, USA, and Morocco) were accepted. The papers were presented in 2 invited plenary sessions and 16 technical sessions.
The 3rd International Conference on High Voltage Engineering and Power Systems 2021 (ICHVEPS 2021) is the third biannual conference organized by the School of Electrical Engineering and Informatics, Institut Teknologi Bandung, Indonesia as an international forum for exchange ideas, discussion and dissemination of research results and technologies in the field of High Voltage Engineering and Power System. This conference is suitable to be attended by university professors and lecturers, post-graduate and under-graduate students, power utilities engineers, researchers from industries and research institutes, and professionals in the field of electrical power engineering, especially relate with high voltage engineering and power system.

ICHVEPS 2021 is technically sponsored by IEEE Indonesia Section, Power and Energy Society Indonesia Chapter IEEE ITB Student Branch and sponsor Indonesia Inter-University Forum on High Voltage Engineering (FOSTU).

The ICHVEPS 2021 is a biannual conference organized by the School of Electrical Engineering and Informatics, with support of PT PLN (Persero), PT. Indonesia Comnets Plus, PT. LAPI and technically sponsored by IEEE Indonesia Section, Power and Energy Society Indonesia Chapter, and Indonesia Inter-University Forum on High Voltage Engineering.
*Participant can join directly to breakout room or will be assigned by committee based on appropriate PTS Code
** Breakout room for other information such as administration, payment receipt etc.

The detail of technical instruction is described in the following description.

Preparation and Plenary Session Technical Instruction
1. Conference will be conducted using ZOOM Application. The App can be downloaded at https://zoom.us/download

2. All of the participants can join ICHVEPS 2021 by click https://bit.ly/Zoom_ICHVEPS_2021 or input the following Meeting ID and Password.
   Meeting ID : 5892814192
   Password : 2ed3Gn
3. By following the procedure before, the participant will join “Main Session” room. Please rename your account by following format: PTS X-Y_PaperNumber_Name. (for example: PTS 2-3_141_Ilham Muliawan)

*PTS position and Paper Number can be seen in the program book

The following figures show the procedure to rename your account

- Click the icon “participants” on your zoom display
- Point your pointer to your name and click “more”
- Click the “rename” sub menu and please fill with appropriate format
4. The Plenary session will be presented on this “Main Session” virtual room.
5. Presentation for invited speaker would be divided into 2 parts:
   - Presentation: 20 minutes
   - QnA: 5 minutes
1. For parallel session, participants will be asked to join breakout based on PTS number.
   The following figures show the procedure to join “Breakout Rooms”:
   - Click “Breakout Rooms” on the menu bar
   - Click the room which appropriate with your PTS number

2. Participant could do the presentation based on the schedule stated on program book guided by session chair and session co-chair
3. Presenter will be confirmed for the presence and presentation mode (video / live presentation)
4. Presentation for presenter would be divided into 2 parts:
   - Presentation : 10 minutes
   - QnA : 5 minutes
5. In QnA session, Participants are allowed to ask after the presentation by using chat menu.

6. Participants on other session are allowed to enter the desired breakout room.

7. For other information such as administration, payment receipt etc., participants can contact the committee by joining the breakout room in “secretariat of ICHVEPS 2021”.
1. Presentation Video Author of the accepted paper is required to pre-record their video presentation and upload the video. The pre-recorded video will be played to the conference participants during the conference period.
   a. Presentation Template Please use ICHVEPS2021 conference PowerPoint slide template which is available at https://bit.ly/ichveps2021video. Please do not change the slide size (slide size used is widescreen 16:9).
   b. Video Requirement Videos should contain a prominent view of the presentation slides, along with audio of the spoken presentation.
      - Presentation video duration: 10 minutes
      - File Format: MPEG-4 (.mp4) file (use the normal H.264 video and AAC audio codecs)
      - Video Size: Maximum of 300MB
      - Video Setting: HD (1280 x 720 pixels or other “720p” setting) in horizontal format with the ratio of 16:9.
      - Audio Quality: please double check your files before submitting to make sure the audio is clear and audible!

Optionally videos may contain a shot of the speaker’s face for increased engagement. This shot should be thumbnail-sized and overlaid on the slide images as shown below.
2. Optional Video Recording Software 

Presentation software allows recording audio and video directly in the application and can export appropriate video files. Please see the notes below for detailed instructions for PowerPoint and if you use a different application, please see the notes under Other Options.

a. PowerPoint

- Follow these instructions to add audio (and optionally video) to your slides. https://support.microsoft.com/en-us/office/record-a-slide-show-with-narration-and-slidetimings-0b9502c6-5f6c-40ae-b1e7-e47d8741161c?ui=en-us&rs=en-us&ad=us
- Follow these instructions to generate a MPEG-4 (.mp4) file from your slides and audio/video. https://support.microsoft.com/en-us/office/turn-your-presentation-into-a-video-c140551f-cb37-4818-b5d4-3e30815c3e83?ui=en-us&rs=en-us&ad=us

b. Other Options

- Record your screen (and microphone) while giving the presentation. There are effective and free options to do this on Linux, macOS, and Windows.
- As a last resort, and only if you are comfortable directly editing video, you can export your slides as images, record an audio track, and combine the two using software like Adobe Premiere Pro, iMovie, or others.

3. Upload Video After recorded the video presentation, please upload the video (in MP4 format) through any drive link (e.g. Google Drive, We Transfer) and send to our email address. Please send the drive link only to ichveps2021@stei.itb.ac.id
**Tuesday, 5th October 2021 (Time UTC+07)**

<table>
<thead>
<tr>
<th>Time</th>
<th>Session</th>
<th>Speaker</th>
<th>Topic</th>
</tr>
</thead>
<tbody>
<tr>
<td>08.00</td>
<td>Opening</td>
<td></td>
<td></td>
</tr>
<tr>
<td>08.30</td>
<td>Plenary 1-1:</td>
<td><strong>Eduard Mulyadi</strong> [Auburn University, US]</td>
<td><em>Renewable Energy Deployment for a Large Scale System Integration and Microgrids</em></td>
</tr>
<tr>
<td>08.30</td>
<td>Plenary 1-2:</td>
<td><strong>Pekik Argo Dahono</strong> [ITB, Indonesia]</td>
<td><em>New Family of Voltage Source Converters Derived Using New Basic Cell for Microgrid Applications</em></td>
</tr>
<tr>
<td>08.55</td>
<td>Plenary 1-3:</td>
<td><strong>Masayuki Hikita</strong> [Kyushu Institute of Technology, Japan]</td>
<td><em>Research Trends in Online Partial Discharge Monitoring and Diagnosis Utilizing ICT in Electric Power Equipment</em></td>
</tr>
<tr>
<td>09.20</td>
<td>Plenary 1-4:</td>
<td><strong>Guan-Jun Zhang</strong> [Xi’an Jiaotong University, China]</td>
<td><em>Research on Insulation Defect Localization Technology of Power Equipment</em></td>
</tr>
<tr>
<td>09.45</td>
<td>Plenary 1-5:</td>
<td><strong>Tumiran</strong> [UGM, Indonesia]</td>
<td><em>Potential of Biomass as Renewable Energy Source for Sustainable Electricity Supply in Eastern Indonesia</em></td>
</tr>
<tr>
<td>10.35</td>
<td>Break</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10.45</td>
<td>Parallel 1-1:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10.45</td>
<td>Parallel 1-2:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10.45</td>
<td>Parallel 1-3:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10.45</td>
<td>Parallel 1-4:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>12.45</td>
<td>Break</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Parallel Technical Session 2 (PTS 2):
- **PTS 2-1:** Rotating Machine & Power Transformer Insulation
- **PTS 2-2:** Renewable Energy Integration
- **PTS 2-3:** Apparatus Protection
- **PTS 2-4:** Energy Demand & Power System Economics

<table>
<thead>
<tr>
<th>Time</th>
<th>Session Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>13.30 - 15.30</td>
<td>PTS 2-2: Renewable Energy Integration</td>
</tr>
<tr>
<td></td>
<td>PTS 2-3: Apparatus Protection</td>
</tr>
<tr>
<td></td>
<td>PTS 2-4: Energy Demand &amp; Power System Economics</td>
</tr>
<tr>
<td><strong>15.30 - 15.50</strong></td>
<td>Break</td>
</tr>
<tr>
<td>15.50 - 17.35</td>
<td>Parallel Technical Session 3 (PTS 3):</td>
</tr>
<tr>
<td></td>
<td>PTS 3-1: Power Cable &amp; Paper Insulation</td>
</tr>
<tr>
<td></td>
<td>PTS 3-2: Microgrid</td>
</tr>
<tr>
<td></td>
<td>PTS 3-3: Power System</td>
</tr>
<tr>
<td></td>
<td>PTS 3-4: Metering Infrastructure</td>
</tr>
</tbody>
</table>

Join Zoom Meeting


---

**Wednesday, 6th October 2021 (Time UTC+07)**

### Plenary Session 2-1:
**MV Reddy**  
Research Hydro-Québec, Canada  
*Advances in High voltage Materials for high power electric vehicles, grids for a sustainable environment*

<table>
<thead>
<tr>
<th>Time</th>
<th>Session Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>08.00 - 08.25</td>
<td>Plenary Session 2-1:</td>
</tr>
<tr>
<td>08.25 - 08.50</td>
<td><strong>Udaya K. Madawala</strong></td>
</tr>
<tr>
<td></td>
<td>The University of Auckland New Zealand</td>
</tr>
<tr>
<td></td>
<td>EV Charging : Challenges and Solutions</td>
</tr>
</tbody>
</table>

### Plenary Session 2-3:
**A.P. Purnomoadi**  
PT. PLN (Persero), Indonesia  
*An Approach for Quantifying Risk of Asset Failure in a Power System Business*

<table>
<thead>
<tr>
<th>Time</th>
<th>Session Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>08.50 - 09.15</td>
<td>Plenary Session 2-3:</td>
</tr>
<tr>
<td>09.15 - 09.40</td>
<td><strong>N. Pattanadech</strong></td>
</tr>
<tr>
<td></td>
<td>KMITL, Thailand</td>
</tr>
<tr>
<td></td>
<td>Application of Polarization and Depolarization</td>
</tr>
<tr>
<td></td>
<td>Current Measurement for Rotating Machine Insulation</td>
</tr>
<tr>
<td></td>
<td>Analysis</td>
</tr>
</tbody>
</table>
Plenary Session 2-5:

**Suwarno**
ITB, Indonesia
*Understanding of Outdoor Insulator Characteristics through Leakage Current and Electrical Equivalent Circuit*

09.40 - 10.05

10.05 - 10.15 Break

Parallel Technical Session 4 (PTS 4):
PTS 4-1: Power Electronics, Rotating Machine
PTS 4-2: Transient Phenomena and Protection
PTS 4-3: High Voltage Engineering
PTS 4-4: Partial Discharge Monitoring

10.15 - 12.15

12.15 - 13.00 Break

Plenary Session 3-1:

**A. Abu-Siada**
Curtin University, Australia
*An Effective Damping Control Scheme to Improve Inter-Area Power System Stability*

13.00 - 13.25

Plenary Session 3-2:

**Andrea Cavallini**
University of Bologna, Italy
*Towards the 2nd Edition of IEC 60034-18-41: Challenges and Perspectives*

13.25 - 13.50

Plenary Session 3-3:

**Gilbert Teyssedre**
CNRS and University Paul Sabatier, France
*Charge Trap Spectroscopies in Polymer Dielectrics: Application to BOPP*

13.50 - 14.15

Plenary Session 3-4:

**Nanang Hariyanto**
ITB, Indonesia
*Maximum Penetration of VRE in to Grid*

14.15 - 14.40

Plenary Session 3-5:

**R. Sarathi**
Indian Institute of Technology Madras, India
*Influence of Corona Ageing on Electrical and Mechanical behaviour of Epoxy Micro-Nanocomposites*

14.40 - 15.05
<table>
<thead>
<tr>
<th>Time</th>
<th>Session</th>
</tr>
</thead>
<tbody>
<tr>
<td>15.05 - 15.25</td>
<td>Break</td>
</tr>
<tr>
<td></td>
<td>Parallel Technical Session 5 (PTS 5):</td>
</tr>
<tr>
<td></td>
<td>PTS 5-1: Power Transformer Diagnostics</td>
</tr>
<tr>
<td>15.25 - 16.55</td>
<td>PTS 5-2: Power System Protection</td>
</tr>
<tr>
<td></td>
<td>PTS 5-3: Asset Management</td>
</tr>
<tr>
<td></td>
<td>PTS 5-4: Power Quality</td>
</tr>
<tr>
<td>16.55 - 17.25</td>
<td>Closing</td>
</tr>
</tbody>
</table>
1. Each Plenary Sessions are conducted in main room of Zoom.
2. Each invited speaker in Plenary Session is given 30 minutes with details of 20 minutes for presentation and 10 minutes for discussion.

Date: Tuesday, October 5th, 2021
Time: 08.30 – 10.35 WIB/UTC+7
Chair: Suwarno, ITB, Indonesia

08.30 – 08.55
Plenary Session 1-1
**Eduard Mulyadi**
Auburn University, US
Renewable Energy Deployment for a Large Scale System Integration and Microgrids

08.55 – 09.20
Plenary Session 1-2
**Pekik Argo Dahono**
ITB, Indonesia
New Family of Voltage Source Converters Derived Using New Basic Cell for Microgrid Applications

09.20 – 09.45
Plenary Session 1-3
**Masayuki Hikita**
Kyushu Institute of Technology, Japan
Research Trends in Online Partial Discharge Monitoring and Diagnosis Utilizing ICT in Electric Power Equipment
09.45 – 10.10  
Plenary Session 1-4  
**Guan-Jun Zhang**  
Xi’an Jiaotong University, China  
Research on Insulation Defect Localization Technology of Power Equipment

10.00 – 10.35  
Plenary Session 1-5  
**Tumiran**  
UGM, Indonesia  
Potential of Biomass as Renewable Energy Source for Sustainable Electricity Supply in Eastern Indonesia

---

Date : Wednesday, 6th October 2021  
Time : 08.00 – 10.05 WIB/UTC+7  
Chair : Fathin Saifur Rahman, ITB  
Umar Khayam, ITB, Indonesia

08.00 – 08.25  
Plenary Session 2-1  
**M.V. Reddy**  
Institute of Research Hydro-Québec, Canada  
Advances in High Voltage Materials for High Power Electric Vehicles, Grids for A Sustainable Environment

08.25 – 08.50  
Plenary Session 2-2  
**Udaya K. Madawala**  
The University of Auckland New Zealand  
EV Charging: Challenges and Solutions
08.50 – 09.15
Plenary Session 2-3
A.P. Purnomoadi
PT. PLN (Persero), Indonesia
An Approach for Quantifying Risk of Asset Failure in a Power System Business

09.15 – 09.40
Plenary Session 2-4
N. Pattanadech
KMITL, Thailand
Application of Polarization and Depolarization Current Measurement for Rotating Machine Insulation Analysis

09.40 – 10.05
Plenary Session 2-5
Suwarno
ITB, Indonesia
Understanding of Outdoor Insulator Characteristics through Leakage Current and Electrical Equivalent Circuit
Date: Wednesday, 6th October 2021
Time: 13.00 – 15.05 WIB/UTC+7
Link: https://bit.ly/Zoom_ICHVEPS_2021
Chair: Deny Hamdani, ITB, Indonesia
Sarjiya, UGM, Indonesia

13.00 – 13.25
Plenary Session 3-1
A. Abu-Siada
Curtin University, Australia
An Effective Damping Control Scheme to Improve Inter-Area Power System Stability

13.25 – 13.50
Plenary Session 3-2
Andrea Cavallini
University of Bologna, Italy
Towards the 2nd Edition of IEC 60034-18-41: Challenges and Perspectives

13.50 – 14.15
Plenary Session 3-3:
Gilbert Teyssedre
CNRS and University Paul Sabatier, France
Charge Trap Spectroscopies in Polymer Dielectrics: Application to BOPP

14.15 – 14.40
Plenary Session 3-4:
Nanang H.
ITB, Indonesia
Maximum Penetration of VRE in to Grid

14.40 – 15.05
Plenary Session 3-5
R. Sarathi
Indian Institute of Technology Madras, India
Influence of Corona Ageing on Electrical and Mechanical behaviour of Epoxy Micro-Nanocomposites.
1. Each Technical Session has 6-8 (eight) presenters.
2. Each parallel session is divided into different Breakout Room of Zoom. Each Breakout room is guided by 1 (one) session chair and 1 (one) session co-chair.
3. Time for each session is controlled by 1 (one) committee as the timekeeper.
4. Each presenter is given 15 minutes with details of 10 minutes for presentation and 5 minutes for questions and answers.
5. In case the presenter gets lost internet connection (or has bad internet connection), the committee will assist to play the presentation video from the author.

Tuesday, 5th October 2021

PTS 1-1
Session theme : Insulator
Time : 10.45 – 12.00 WIB/UTC+7
Chair A : Salama Manjang, Hasanuddin University
Chair B : Fathin Saifur Rahman, ITB
Committee : Adit Firmansyah & Ari Mukti

<table>
<thead>
<tr>
<th>No.</th>
<th>Time</th>
<th>Paper No.</th>
<th>Title, Author &amp; Institution</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>10.45</td>
<td>39</td>
<td>Study on Equivalent Circuit of Epoxy Resin Insulators based on Leakage Current Waveforms Under Clean Fog Conditions  Adjie Bagaskara, Suwarno  School of Electrical Engineering and Informatics, Institut Teknologi Bandung Bandung, Indonesia</td>
</tr>
<tr>
<td>2</td>
<td>11.00</td>
<td>80</td>
<td>Study of Leakage Current Characteristics of High Voltage Insulators Ageing After Dry Season in Polluted Environmental Conditions  Salama Manjang, Syafaruddin, Tambi, Ikhlas Kitta, Mustarum Musaruddin  Department of Electrical Engineering Hasanuddin University Makassar, Indonesia, Department of Electrical Engineering. Halu Oleo University Kendari, Indonesia</td>
</tr>
</tbody>
</table>
| 3 | 11.15 | 21 | **Effect of Artificial Aging on Silicone Rubber Polymeric Insulators Performance at Various Environmental Conditions**  
Adib Akbar Jaelani, Shafa Nabila Haya, Suwarno, Lunnetta Safura L.  
School of Electrical and Informatics Engineering Bandung Institute of Technology Ganeca St. 10, Bandung, 40132, Indonesia |
| 4 | 11.30 | 30 | **Effects of UV Radiation and Contaminant on The Properties of Polymeric Insulator**  
Muhammad Ridhwan, Lunnetta Safura Lumba, Suwarno  
School of Electrical Engineering and Informatics, Institut Teknologi Bandung Bandung, Indonesia |
| 5 | 11.45 | 27 | **Accelerated Aging Study on Silicone Rubber Insulator with Contaminant Level and Fog Conductivity Variations**  
Shafa Nabilla Haya, Adib Akbar Jaelani, Lunnetta Safura Lumba, Suwarno  
School of Electrical Engineering and Informatics, Institut Teknologi Bandung Bandung, Indonesia |
Tuesday, 5th October 2021  
PTS 1-2  
Session theme: Renewable Energy  
Time: 10.45 – 12.00 WIB/UTC+7  
Chair A: Burhanuddin Halimi, ITB  
Chair B: Ignatius Rendroyoko, ITB  
Committee: Fahmi Nurul Alimi & Ilham Muliawan  

<table>
<thead>
<tr>
<th>No.</th>
<th>Time</th>
<th>Paper No.</th>
<th>Title, Author &amp; Institution</th>
</tr>
</thead>
</table>
| 1   | 10.45 | 111       | Enhancing the Power and Efficiency of Photovoltaic Panel Using Heat Sinks with fans  
Zaid Khudhur Hussein¹, Jenan Ayad², Hanan j. Abdulkareem³ Hadi Jameel Hadi⁴  
¹,³Medical Instrumentation Technical Engineering, Al-Esraa University College Baghdad, Iraq  
²Computer Technology Engineering, Al-Esraa University College Baghdad, Iraq  
⁴Electrical Engineering Department Oil Products Distribution Company Baghdad, Iraq |
| 2   | 11.00 | 82        | Design A Low-cost PV Performance Ratio Data Monitoring  
Yuli Astriani, Dionysius A. Renata, Khotimatul Fauziah, Asih Kurniasari, Hafsah Halidah, Riza  
National Laboratory for Energy Conversion Technology, BPPT Tangerang Selatan, Indonesia |
| 3   | 11.15 | 61        | Hourly Day-ahead Solar Energy Prediction For Supporting Smart Grid Implementation in Semau Island  
Ignatius Rendroyoko¹, Hugo Hadi Suhana², Yvon Besanger³  
¹School of Electrical Engineering and Informatics, Institut Teknologi Bandung Bandung, Indonesia  
²Electrical Engineering, Trisakti University, PT. Icon+ Jakarta, Indonesia  
³Univ. Grenoble Alpes, CNRS, Grenoble, INP, Grenoble, France |
| 4 | 11.30 | 62 | **Analysis of Thermal Storage Temperature Control for Solar Thermal Power Plant**  
Fauzi Handy Dewanto, Burhanuddin Halimi  
School of Electrical and Informatic, Institut Teknologi Bandung, Bandung, Indonesia |
|---|---|---|---|
| 5 | 11.45 | 129 | **Design of Defense Scheme Based on Adaptive Under Frequency Load Shedding (AUFLS) at Lombok Island Grid System**  
Dede Rilwan Alwaini, Hasna Satya Dini  
Faculty of Electricity and Renewable Energy Institut Teknologi PLN Jakarta, Indonesia |
Tuesday, 5th October 2021
PTS 1-3
Session theme : GIS
Time : 10.45 – 12.00 WIB/UTC+7
Chair A : Umar Khayam, ITB
Chair B : Akhilesh Kumar Pandey, JKLU University
Committee : Jean Pierre Uwiringiyimana & Syadilla Refiasto
Link : https://bit.ly/Zoom_ICHVEPS_2021

<table>
<thead>
<tr>
<th>No.</th>
<th>Time</th>
<th>Paper No.</th>
<th>Title, Author &amp; Institution</th>
</tr>
</thead>
</table>
| 1   | 10.45| 97        | Characteristics of Dissolved Gas Evolution Rate under Different Loading Factors  
Heri Sutikno¹, Rahman Azis Prasojo², Suwarno³  
¹Human Talent Development Department, PT PLN (Persero) Jakarta, Indonesia.  
²Department of Electrical Engineering Politeknik Negeri Malang, Indonesia.  
³School of Electrical Engineering and Informatics, Institut Teknologi Bandung Bandung, Indonesia |
| 2   | 11.00| 144       | Finite Element Analysis of Electric Field Distribution in C4F7N as an Alternative to SF6 for Electrical Insulation  
Rizwan Ahmad¹, Rahisham Abd Rahman², Ali Ahmed Salem³, Nor Akmal Mohd Jamail⁴, Azhan Ab Rahman⁵, Hafisoh Abdul Ahmad⁶  
¹²⁴Department of Electrical Power Engineering, Universiti tun Hussein Onn Malaysia ³Institute of High Voltage and High Current, Universiti Teknologi Malaysia, Skudai Johor ⁵Faculty of Electrical and Electronic Engineering Technology, Universiti Teknikal Malaysia, Melaka ⁶School of Electrical System, Universiti Malaysia Perlis Arau, Malaysia |
| 3 | 11.15 | 133 | **Design and implementation of Experimental Setup for Measurement of Partial Discharge on GIS**  
Arpan Zaeni, Burhanuddin Halimi, Umar Khayam, Suwarno  
School of Electrical Engineering and Informatics, Institut Teknologi Bandung, Bandung, Indonesia |
|---|---|---|
| 4 | 11.30 | 108 | **Determination of Insulating Properties of SO₂ gas from BOLSIG+ Calculated Swarm Transport Coefficients**  
Akhilesh Kumar Pandey¹, Pushpendra Singh², Mohd. Shahnawaz Khan³, Jitendra Kumar Singh⁴  
¹²⁴Dept of Electrical Engineering, Institute of Engineering & Technology J K Lakshmipat University, Jaipur India  
³Dept of Chemistry, Institute of Engineering & Technology J K Lakshmipat University Jaipur India |
| 5 | 11.45 | 24 | **Effects of Notches in GIS Spacer Design to Hold Conductor Rods on Electric Field Distribution**  
Muhammad R. Fabio, Syarif Hidayat, Umar Khayam  
Department of Electrical Power Engineering, School of Electrical Engineering and Informatics, Institut Teknologi Bandung, Bandung, Indonesia. |
## Session Theme: Electricity Planning & Power System Application

**Time:** 10.45 – 12.45 WIB/UTC+7

**Chair A:** Kevin Marojahan Banjar Nahor, ITB  
**Chair B:** Pradita Octovianandiningrum Hadi, ITB  
**Committee:** Farradita Nugraha & Taufik Rhamdhani


<table>
<thead>
<tr>
<th>No.</th>
<th>Time</th>
<th>Paper No.</th>
<th>Title, Author &amp; Institution</th>
</tr>
</thead>
</table>
Tumiran¹, Sarjiya², Lesnanto Multa Putranto³, Edwin Nugraha Putra⁴, Rizki Firmansyah Setya Budi⁵, Candra Febri Nugraha⁶  
¹²³⁵⁶Department of Electrical and Information Engineering Universitas Gadjah Mada Yogyakarta, Indonesia ⁴System Planning Division PT PLN (Persero) Jakarta, Indonesia |
| 2   | 11.00 | 165       | **Optimized Allocation of Solar PV in Batam-Bintan Power System 2021-2025**  
Devni Syafrianto, Kevin Marojahan Banjar-Nahor, Nanang Hariyanto  
School of Electrical Engineering & Informatics Institut Teknologi Bandung Bandung, Indonesia |
| 3   | 11.15 | 120       | **Micro-Spatial Electricity Planning in Urban Area Based on Energy Demand**  
Oktaria Handayani¹, Adri Senen², Christine Widyastuti³, Dian Yayan Sukma⁴  
¹²³Department of Electrical Engineering Institut Teknologi PLN Jakarta, Indonesia ⁴Department of Electrical Engineering Universitas Riau Pekanbaru, Indonesia |
<p>| | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
</table>
| **4** | 11.30 | 162 | **Thermal Valorization of the LED by a Thermoelectric Generator**  
Ahlem Ben Halima\(^1\), Zouhour Araoud\(^2\)  
Laurent Canale\(^3\), Kamel Charrada\(^4\), Georges Zissis\(^5\)  
\(^{1,2,4}\)Research Unit of Ionized and Reactive Media (EMIR) Monastir, Tunisia  
\(^{3,5}\)IEEE Senior Member, LAPLACE, Université de Toulouse, CNRS, INPT, UPS, Toulouse, France |
| **5** | 11.45 | 92 | **Development of Smart Outlet for Active Power Usage**  
Lei Xiong\(^1\), Goro Fujita\(^2\), Takashi Minemura\(^3\)  
\(^{1,2}\)Power System Lab, Shibaura Institute of Technology Tokyo, Japan  
\(^3\)President and Representative Director, Minemura Electrical Engineering Corp Nagano, Japan |
| **6** | 12.00 | 143 | **Design of Street Light Revitalization using Dialux Evo**  
Credo Malouna Saragih, Syamsir Abduh  
Department of Electrical Engineering Trisakti University, Jakarta, Indonesia |
| **7** | 12.15 | 155 | **Developing an Innovative Strategy to Achieve Energy Saving for Air Conditioning**  
Marwan Marwan\(^1\), Tri Harianto\(^2\), Dahlang Tahir\(^3\)  
\(^1\)Electrical Engineering Department Polytechnic State of Ujung Pandang Makassar, Indonesia  
\(^2\)Civil Engineering Department Hasanuddin University Makassar, Indonesia  
\(^3\)Physics Department Hasanuddin University Makassar, Indonesia |
| **8** | 12.30 | 160 | **Review of Recent Research on Energy Saving Lamp in Indonesia**  
Umar Khayam, Arpan Zaeni  
School of Electrical Engineering and Informatics Institut Teknologi Bandung Bandung, Indonesia |
Tuesday, 5th October 2021

PTS 2-1

Session theme: Rotating Machine & Power Transformer Insulation

Time: 13.30 – 15.00 WIB/UTC+7

Chair A: Rahman Azis Prasojo, ITB

Chair B: Bhaba Das, Hitachi ABB

Committee: Adit Firmansyah & Ari Mukti


<table>
<thead>
<tr>
<th>No.</th>
<th>Time</th>
<th>Paper No.</th>
<th>Title, Author &amp; Institution</th>
</tr>
</thead>
</table>
| 1   | 13.30 | 32        | Effects of Loading Factor on the Condition of Insulating Paper in Power Transformer  
Nuriyanto Eko Saputro, Rahman Azis Prasojo, Geby Chintia, Suwargo  
School of Electrical Engineering & Informatics Bandung Institute of Technology, Bandung, Indonesia |
| 2   | 13.45 | 118       | Application and Comparative Analysis of Fuzzy Inference System for Transformer Fault Diagnosis with Dissolved Gases in Oil  
Mehmet Murat Ispirli¹, Hasan Adali², Özcan Kalenderli³, Mehmet Zeki Celik⁴, Bülent Oral⁵  
¹,²Dept. of Electrical Engineering Istanbul Technical University Istanbul, Turkey  
²Field Engineering BEST Transformer Corp., Balikesir, Turkey  
³Live Line Maint. Engineering of Head, Turkish Electricity Trans. Corp, Istanbul, Turkey  
⁴Dept. of Electrical-Electronics Engineering Marmara University, Istanbul, Turkey |
<table>
<thead>
<tr>
<th></th>
<th>Time</th>
<th>序号</th>
<th>演讲题目</th>
<th>演讲者</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>14.00</td>
<td>100</td>
<td>High Voltage Insulation Failure on HV Current Transformer: A Case Study in Diagnosis of HV CT Failure at Bekasi 150 kV Substation</td>
<td>I Gusti Ngurah Mahendrayana, Imam Makhfud, Arfan Idha Norgiyanto, Zainur Oktafian Prabandaru, Winarno</td>
</tr>
<tr>
<td>4</td>
<td>14.15</td>
<td>16</td>
<td>Oil Insulation Analysis due to Electrical Arcing of Power Transformers Degradation</td>
<td>Syahputra, Muhammad Rully; Prasetyo, Mirza Farhan; Sufianto, Abdul Muiz; Septyani, Henny Ika</td>
</tr>
<tr>
<td>5</td>
<td>14.30</td>
<td>37</td>
<td>Cost and Benefit Analysis on Treatment Method of Aged Power Transformer Insulating Oil</td>
<td>Harry Gumilang</td>
</tr>
<tr>
<td>6</td>
<td>14.45</td>
<td>29</td>
<td>Nursing Sick Transformers Using Online Dissolved Gas Monitors</td>
<td>Bhaba Das</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Transformers Business Unit Hitachi ABB Power Grids Singapore</td>
</tr>
<tr>
<td>No.</td>
<td>Time</td>
<td>Paper No.</td>
<td>Title, Author &amp; Institution</td>
<td></td>
</tr>
<tr>
<td>-----</td>
<td>--------</td>
<td>-----------</td>
<td>-----------------------------</td>
<td></td>
</tr>
</tbody>
</table>
| 1   | 13.30  | 31        | Solar PV-Wind Turbine Integration in Hydrogen Production to Generate Electricity through Fuel Cell  
Syahril A. Ginanjar, Burhanuddin Halimi, Arwindra Rizkiawan  
School of Electrical Eng. & Informatics Bandung Institute of Technology |
| 2   | 13.45  | 45        | Integration of Large-Scale Photo-Voltaic Based Generation into Power Systems  
Muhammad A. Tayyab  
Dept of Elec. & Computer Engineering, Auburn University, Auburn, Alabama, USA |
| 3   | 14.00  | 136       | System Optimization Design Of Rooftop Grid-Tied Solar Power Plant For Residential Customers In Indonesia  
Naftalin Winanti¹, CH A Andre Mailoa², Handoko Rusiana Iskandar³, Giri Angga Setia⁴, Nivika Tiffany Somantri⁵  
¹,²,³,⁴,⁵Electrical Engineering Department Faculty of Engineering Universitas Jenderal Achmad Yani Cimahi, Indonesia  
²Faculty of Mathematic and Natural Science Bandung Institute of Technology Bandung, Indonesia |
| 4   | 14.15  | 137       | Optimization of the Hybrid Power Plant Design (PV-Wind) for Residential Load  
Giri Angga Setia, Ziega Zetu Zuen, Fauzia Haz, Handoko Rusiana Iskandar, Naftalin Winanti, M Reza Hidayat  
Electrical Engineering Department, Faculty of Engineering Universitas Jenderal Achmad Yani Cimahi, Indonesia |
<table>
<thead>
<tr>
<th>Page</th>
<th>Time</th>
<th>Session</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>14.30</td>
<td>9</td>
</tr>
</tbody>
</table>
|      |        | **Steady State Load Flow Model of DFIG-Based Wind Turbine in Voltage Control Mode**  
|      |        | Rudy Gianto  
|      |        | Department of Electrical Engineering  
|      |        | Tanjungpura University Pontianak, Indonesia |
| 6    | 14.45  | 76      |
|      |        | **Characterizing a 40-MW Modern Wind Power Plant by Field Data Measurements**  
|      |        | Thoa Le Thanh¹, Eduard Muljadi², Dieu Vo Ngoc³ Irving Paul Girsang⁴  
|      |        | ¹,³ Dept. of Power Systems Ho Chi Minh City University of Technology, Vietnam National University Ho Chi Minh City  
|      |        | ²,⁴ Dept. of Electrical and Computer Engineering, Auburn University, Alabama, United States |
Tuesday, 5th October 2021  
PTS 2-3  
Session theme : Apparatus Protection  
Time : 13.30 – 14.45 WIB/UTC+7  
Chair A : Ariadi Hazmi, Andalas University  
Chair B : Kevin Marojahan Banjar Nahor, ITB  
Committee : Jean Pierre Uwiringiyimana & Syadilla Refiasto  

<table>
<thead>
<tr>
<th>No.</th>
<th>Time</th>
<th>Paper No.</th>
<th>Title, Author &amp; Institution</th>
</tr>
</thead>
</table>
| 1   | 13.45 | 26        | **Analysis of Bentonite AC and DC Performance Under Water Content and Chemical Content Variation for Grounding Applications**  
Zakka Izzatur Rahman Noor, Bambang Anggoro Soedjarno P, Pradita Octoviananingrum Hadi  
Electrical Power Engineering School of Electrical Engineering and Informatics, Bandung Institute of Technology, Bandung, Indonesia. |
| 2   | 14.00 | 83        | **Lightning and Grounding Parameters Effect to Flashover on 150kV Transmission Line**  
Novizon*, Silvia Wulandari, Nurfi Syahri  
Electrical Engineering Department Universitas Andalas Padang, Indonesia. |
| 3   | 14.15 | 25        | **Study of Transmission Lightning Protection Installation in South Sumatera**  
A S Habibie, M Ridwan, K G H Mangunkusumo, Srijono, A S Surya, D R Jintaka  
Ristek TND PLN Research Institute, Jakarta Indonesia. |
Installation of Multi Chamber Arrester to Improve Lightning Reliability Performance of Distribution Lines System in Oil and Gas Area
Syadila Refiasto, Bryan Denov, Suwarno, Reynaldo Zoro
School of Electrical Engineering and Informatics Institut Teknologi Bandung, Bandung, Indonesia.

500 kV Quadruple Circuit Compact Transmission Line Redesign Study To Reduce The Impact Of Lightning Strikes
Joko Hartono, Muhammad Ridwan, Muhammad Muslih Mafruddin, Hakim Habibi, Erny Anugrahany
Transmission and Distribution Department, PLN Research Institute, Jakarta, Indonesia.
Tuesday, 5th October 2021
PTS 2-4
Session theme: Energy Demand & Power System Economics
Time: 13.30 – 15.30 WIB/UTC+7
Chair A: Sarjiya, UGM
Chair B: Hasna Satya Dini, Institut Teknologi PLN
Committee: Farradita Nugraha & Taufik Rhamdhani

<table>
<thead>
<tr>
<th>No.</th>
<th>Time</th>
<th>Paper No.</th>
<th>Title, Author &amp; Institution</th>
</tr>
</thead>
</table>
| 1   | 13.30  | 122       | **Micro-Spatial Projection Of Energy Demand Based On Dominant Factors Identification: An Exploratory Factor Analysis**  
Dwi Anggaini, Adri Senen, Hasna Satya Dini  
Teknik Elektro Institut Teknologi PLN Jakarta, Indonesia |
| 2   | 13.45  | 10        | **Electricity Consumption Management System Design using Load Scheduling Method Based on Internet Of Things**  
Zaini, Adelina Utari  
Faculty of Engineering Andalas University Padang, Indonesia |
| 3   | 14.00  | 22        | **Comparative Power and Energy Consumptions between Scheduled and Fuzzy Controlling on an IoT-based Vertical Farming**  
Waluyo, Andre Widura, Febrian Hadiatna, Delvin Anugerah  
Department of Electrical Engineering Institut Teknologi Nasional Bandung (ITENAS) Bandung, Indonesia |
<table>
<thead>
<tr>
<th>Session</th>
<th>Time</th>
<th>Pages</th>
<th>Title</th>
<th>Authors</th>
</tr>
</thead>
</table>
| 4       | 14.15| 126   | The influence of Wall on Reducing Electrical Energy Consumption for Residential Building | Marwan Marwan\(^1\), Tri Harianto\(^2\), Dahlang Tahir\(^3\)  
\(^1\)Electrical Engineering Department Polytechnic State of Ujung Pandang Makassar, Indonesia \(^2\)Civil Engineering Department Hasanuddin University Makassar, Indonesia \(^3\)Physics Department Hasanuddin University Makassar, Indonesia |
| 5       | 14.30| 152   | Economic and Environmental Assessment of the Implementation of Hybrid Auto-size Diesel Generators with Renewable Energy on Sebesi Island | Ali Muhtar\(^1\), Purwono Prasetyawan\(^2\), Sabhan Kanata\(^3\), Syamsyarief Baqaruzi\(^4\) and Toto Winata\(^5\)  
\(^1\)Electrical Engineering, Center of Research & Innovation for Conservation & Renewable Energy Institut Teknologi Sumatera Lampung, Indonesia \(^2\) \(^3\) \(^4\) \(^5\)Department of Physic Faculty of Math and Science Institut Teknologi Bandung Bandung, Indonesia |
| 6       | 14.45| 33    | Strategy Plan on Electric Vehicle Charging Scheme for Peak Demand Reduction in Residential Area Transformer | Komaruddin\(^1\), Suwarno\(^1\), Nanang Hariyanto\(^1\), Kevin M. Banjar-Nahor\(^1\)  
\(^1\)School of Electrical Engineering and Informatics, Institut Teknologi Bandung, Indonesia \(^2\)PT PLN (Persero), Jakarta, Indonesia |
| 7 | 15.00 | 151 | Minimizing Electrical Energy Costs for Residential Buildings Based on the Characteristic of Walls  
Marwan Marwan¹, Tri Harianto², Dahlang Tahir³  
¹Electrical Engineering Department Polytechnic State of Ujung Pandang Makassar, Indonesia ²Civil Engineering Department Hasanuddin University Makassar, Indonesia ³Physics Department Hasanuddin University Makassar, Indonesia |
|---|---|---|
| 8 | 15.15 | 124 | Financial and Technical Forecast Analysis of a Hybrid Biomass-Diesel Power Plant - Case Study in Tinggi Island, South Bangka  
Ginas Alvianingsih¹, Vendy Antono², Iwa Garniwa³  
¹Faculty of Electricity and Renewable Energy Institut Teknologi PLN Jakarta, Indonesia ²Faculty of Energy Technology and Bussiness Institut Teknologi PLN Jakarta, Indonesia ³Departement of Electrical Engineering Universitas Indonesia Depok, Indonesia |
Tuesday, 5th October 2021
PTS 3-1
Session theme: Power Cable & Paper Insulation
Time: 15.50 – 16.50 WIB/UTC+7
Chair A: Bryan Denov, ITB
Chair B: Arpan Zaeni, ITB
Committee: Adit Firmansyah & Ari Mukti

<table>
<thead>
<tr>
<th>No.</th>
<th>Time</th>
<th>Paper No.</th>
<th>Title, Author &amp; Institution</th>
</tr>
</thead>
</table>
| 1   | 15.50 | 127       | **The Study of Electric Field and Partial Discharges on XLPE Insulation under DC High Voltage using COMSOL Multiphysics**  
Apoorva Sahu, Rakesh Sahoo, and Subrata Karmakar  
Department of Electrical Engineering  
National Institute of Technology Rourkela  
Rourkela, India |
| 2   | 16.05 | 42        | **FTIR and SEM Analysis of Breakdown XLPE Cable Insulation**  
Hakim Habibi, Aji Suryo Alam, Oksa Prasetyawan, Guntur Supriyadi  
Transmission and Distribution Dept, PLN Puslitbang, Jakarta, Indonesia |
| 3   | 16.20 | 142       | **Study The Properties of Mixed Kenaf and Empty Fruit Bunch (EFB) Oil Palm Fibre Insulation Paper**  
Ja’afar Bin Adnan¹, Mohd Taufiq Bin Ishak², Nurul ‘Izzati Binti Hashim³, Fakroul Redzuan Bin Hashim⁴, Rushdan Bin Ibrahim⁵, Rahisham Abd Rahman⁶  
¹,²,⁴Dept. of Electrical and Electronics Engineering, Faculty of Engineering, National Defence University of Malaysia  
Kuala Lumpur, Malaysia; ³Dept. of Electrical Engineering, Faculty of Engineering, National Defence University of Malaysia  
Kuala Lumpur, Malaysia; ⁵Dept. of Electrical Engineering, Faculty of Engineering, National Defence University of Malaysia  
Kuala Lumpur, Malaysia; ⁶Dept. of Electrical Engineering, Faculty of Engineering, National Defence University of Malaysia  
Kuala Lumpur, Malaysia |
and Electronics Engineering, Faculty of Engineering, University Malaysia Sarawak Sarawak, Malaysia; 5Pulp and Paper Laboratory, Forest Research Institute Malaysia, Selangor Malaysia; 6Faculty of Electrical and Electronics Engineering, University Tun Hussein Onn Malaysia, Johor Malaysia

<table>
<thead>
<tr>
<th></th>
<th>16.35</th>
<th>44</th>
</tr>
</thead>
<tbody>
<tr>
<td>Comparative Study of Accelerated Thermal Aging of Papers in Mineral Oil, Natural Ester, and Gas-to-Liquid Ilhamid Daris, Mawla Ahmad, Hardiansyah Rahmat Nurhakim, Suwarno School of Electrical Engineering and Informatics Bandung Institute of Technology, Bandung, Indonesia</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Tuesday, 5th October 2021  
PTS 3-2  
Session theme : Microgrid  
Time : 15.50 – 17.35 WIB/UTC+7  
Chair A : Kevin Marojahan Banjar Nahor, ITB  
Chair B : Syafii, Andalas University  
Committee : Farradita Nugraha & Adit Firmansyah  

<table>
<thead>
<tr>
<th>No.</th>
<th>Time</th>
<th>Paper No.</th>
<th>Title, Author &amp; Institution</th>
</tr>
</thead>
</table>
| 1   | 15.50| 53        | **Power Quality Study of Microgrid with Single Large Solar PV and Distributed Small Solar PVs Plant: Case Study Karampuang Island**  
Ridho Arisyadi, Tri Desmana Rachmilda, Deny Hamdani  
School of Electrical Engineering and Informatics Institut Teknologi Bandung  
Bandung, Indonesia |
| 2   | 16.05| 50        | **Indonesia's New Capital Challenge: Developing Sustainable Business Model for Off-grid Photovoltaic Company**  
Arien Hanadya¹, Bagas Maulana Sutardi²  
¹Master Student, Young Professional MBA SBM-ITB (Institut Teknologi Bandung)  
Bandung, Indonesia, 40132  
²Operations System, UP3B West Kalimantan PLN (Perusahaan Listrik Negara) Pontianak, Indonesia, 78115 |
| 3   | 16.20| 70        | **Military Microgrid in Indonesia**  
Dianing Novita Nurmala Putri, Eddie Widiono Suwondo, Syamsir Abduh, Tyas Kartika Sari, Chairul G Irianto, Maula Sukma Widjaya  
Electrical Engineering Department Universitas Trisakti Jakarta, Indonesia |
| 4 | 16.35 | 63 | **Design and Analysis of Hybrid Off-Grid PV-Battery-Genset System for Communal and Administrative Load Under Cycle Charging Control Strategy at Patippi Village, Papua**  
Abdu Yakan Rosyadi, Agus Purwadi, Muhammad Ridhwan  
School of Electrical Engineering and Informatics, Institut Teknologi Bandung, Indonesia |
|---|---|---|
| 5 | 16.50 | 64 | **Analysis of Hybrid Diesel-Biogas for Palm Oil Mill Electrification and Environmental Sustainability**  
Syafii, Pinto Anugrah, Dewi Kusuma Wardani  
Electrical Engineering Department, Engineering Faculty, Universitas Andalas Padang, Indonesia |
| 6 | 17.05 | 134 | **Optimal Design of Rooftop PV Systems for Electrical Engineering Department Laboratory**  
Handoko Rusiana Iskandar¹, Nana Heryana², Naftalin Winanti³, Giri Angga Setia⁴, Rijal Ridwanulloh⁵, Muhammad Rizky Alfarizi⁶  
¹²³⁴⁵⁶Electrical Engineering Department, Faculty of Engineering, Universitas Jenderal Achmad Yani Cimahi, Indonesia, ²School of Electrical Engineering and Informatics, Institut Technology Bandung Bandung, Indonesia |
| 7 | 17.20 | 168 | **Adaptive Protection Coordination Scheme for Distribution System Under Penetration of Distributed Generation**  
Ra Crystal S. P. Tambun, Kevin M. Banjar-Nahor, Nanang Hariyanto, Fathin Saifur Rahman, Rizky Rahmani  
School of Electrical Engineering and Informatics Institut Teknologi Bandung Bandung, Indonesia. |
Tuesday, 5th October 2021  
PTS 3-3  
Session theme : Power System  
Time : 15.50 – 17.20 WIB/UTC+7  
Chair A : Fathin Saifur Rahman, ITB  
Chair B : Rizky Rahmani, ITB  
Committee : Jean Pierre Uwiringiyimana & Syadilla Refiasto  

<table>
<thead>
<tr>
<th>No.</th>
<th>Time</th>
<th>Paper No.</th>
<th>Title, Author &amp; Institution</th>
</tr>
</thead>
</table>
| 1   | 15.50  | 170       | **Integration Between Supervisory Control and Data Acquisition (SCADA) and DlgSILENT PowerFactory for Real-Time Power System Simulation**  
Muhammad Mushthofa Musyasy, Kevin Marojahan Banjar Nahor, Nanang Hariyanto  
Electrical Power Engineering School of Electrical Engineering and Informatics Bandung Institute of Technology, Bandung, Indonesia |
| 2   | 16.05  | 51        | **Modelling Transposed-150kV-HVTLs West Kalimantan Subsystem and 275kV SEB-PLN Interconnection Voltage Unbalance Mitigation**  
Bagas M. Sutardi  
Operations System, UP3B West Kalimantan PLN (Perusahaan Listrik Negara) Pontianak, Indonesia |
| 3   | 16.20  | 145       | **Study on the Use of Virtual Synchronous Generators to Improve Large Scale System's Stability**  
Diya Li¹, Sandro Sitompul², Goro Fujita³  
¹Electrical Engineering and Computer Science Shibaura Institute of Technology Tokyo, Japan  
²Regional Environment System Shibaura Institute of Technology, Tokyo Japan  
³Department of Electrical Engineering Shibaura Institute of Technology Tokyo, Japan |
<table>
<thead>
<tr>
<th>Page</th>
<th>Time</th>
<th>Duration</th>
<th>Title</th>
<th>Authors</th>
<th>Institution</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>17.05</td>
<td>56</td>
<td><strong>Virtual Synchronous Generator Control Considering Output Upper Limitation</strong></td>
<td>Yuki Hayashi(^1), Sandro Sitompul(^2), Goro Fujita(^3)</td>
<td>(^{1,2})Graduate School of Engineering and Science Shibaura Institute of Technology, Tokyo, Japan; (^3)College of Engineering Shibaura Institute of Technology Tokyo Japan</td>
</tr>
<tr>
<td>7</td>
<td>17.20</td>
<td>171</td>
<td><strong>Optimized Hybrid Power System Configuration for The First Phase of Dedieselization Programs</strong></td>
<td>Devni Syafrianto(^1), Kevin Marojahan Banjar-Nahor(^2), Herry Nugaraha(^3), Dzikri Firmansyah Hakam(^4), Pradita Octaviandiningrum Hadi(^5), Nanang Hariyanto(^6)</td>
<td>(^{1,3,4})Centre of Excellence for Generation &amp; Renewable Energy PT PLN (Persero) Jakarta, Indonesia (^{2,5})School of Electrical Engineering &amp; Informatics Institut Teknologi Bandung Bandung, Indonesia</td>
</tr>
</tbody>
</table>
Tuesday, 5th October 2021
PTS 3-4

Session theme: Metering Infrastructure
Time: 15.50 – 17.05 WIB/UTC+7
Chair A: Pradita Octoviandiningrum Hadi, ITB
Chair B: K. G. H. Mangunkusumo, PLN Research Institute
Committee: Farradita Nugraha & Taufik Rhamdhani
Link: https://bit.ly/Zoom_ICHVEPS_2021

<table>
<thead>
<tr>
<th>No.</th>
<th>Time</th>
<th>Paper No.</th>
<th>Title, Author &amp; Institution</th>
</tr>
</thead>
</table>
| 1   | 15.50| 40        | **Assessment Procedure for Advanced Metering Infrastructure Implementation in Indonesia**  
Erny Anugrahany, Guntur Supriyadi, Dimas Aji Nugraha, Oksa Prasetyawan W., M. Muslih Mafruddin  
Transmission and Distribution R&D PLN Puslitbang Jakarta, Indonesia |
| 2   | 16.05| 35        | **Meter Operation Center Design using Rapid Application Development Technique to Support AMI Implementation**  
Ignatius Rendroyoko¹, Antonius Padeda², Rudy Setyobudi³, Iskandar Nungtjik⁴  
¹Electricity & W.Business Indonesia Comnets Plus Jakarta, Indonesia  
²Electricity Digital Solution Indonesia Comnets Plus Jakarta, Indonesia  
³Smart Meter PT PLN (Persero) Jakarta, Indonesia  
⁴Energy metering expert Indonesia Comnets Plus Jakarta, Indonesia |
| 3   | 16.20| 107       | **Development of Meter Data Management System Based-on Event-Driven Streaming Architecture for IoT-based AMI Implementation**  
Ignatius Rendroyoko¹, Antonius Darma Setiawan², Suhardi³  
¹,³School of Electrical Engineering and Informatics Institute Technology of Bandung Bandung, Indonesia  
²Department of Electrical Engineering Jakarta Global University Jakarta, Indonesia |
| 4  | 16.35 | 15 | Guidance on Communication Media Selection for Advanced Metering Infrastructure in Indonesia  
Transmission and Distribution Department  
PLN Research Institute Jakarta, Indonesia |
|---|---|---|---|
| 5  | 16.50 | 14 | NB-PLC Performance Evaluation for Advanced Metering Infrastructure  
Transmission and Distribution Department  
PLN Research Institute Jakarta, Indonesia |
Wednesday, 6th October 2021
PTS 4-1
Session theme: Power Electronics, Rotating Machine
Time: 10.15 – 11.45 WIB/UTC+7
Chair A: Agus Purwadi, ITB
Chair B: Kevin Marojahan Banjar Nahor, ITB
Committee: Adit Firmansyah & Ari Mukti
Link: https://bit.ly/Zoom_ICHVEPS_2021

<table>
<thead>
<tr>
<th>No.</th>
<th>Time</th>
<th>Paper No.</th>
<th>Title, Author &amp; Institution</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>10.15</td>
<td>113</td>
<td>Application of the Phase Shift Full Bridge Converter for the Single-Phase Full-Bridge Inverter to Improve the Output of the Renewable Energy Thao Huynh Van¹, Thanh Le Van², Tuyet Mai Nguyen Thi³, Minh Quan Duong⁴, Le Xuan Chau⁵ ¹²³⁴University of Science and Technology, The University of Danang Danang, Vietnam ⁵Naval Academy Vietnam Nhatrang Vietnam</td>
</tr>
<tr>
<td>2</td>
<td>10.30</td>
<td>109</td>
<td>Design of AC Electric Vehicle Supply Equipment based on Safety Standard Khotimatul Fauziah¹, Yuli Astriani², Dionysius A. Renata³, Afrias Sarotama⁴, Agus Suhendra⁵, Eka R. Priandana⁶, Riza⁷ ¹²³⁴⁵⁶⁷National Laboratory for Energy Conversion Technology BPPT Serpong, Indonesia ⁴Center of Technology for Electronics BPPT Serpong, Indonesia</td>
</tr>
<tr>
<td>3</td>
<td>10.45</td>
<td>59</td>
<td>A Model Reference Adaptive System for Online Rotor Parameter Estimation of Induction Motors Ikhwan Wiranata, Jihad Furqani, Arwindra Riziawan, Pekik Argo Dahono School of Electrical Engineering and Informatics Institute Technology of Bandung Bandung, Indonesia</td>
</tr>
<tr>
<td></td>
<td>Time</td>
<td>Page</td>
<td>Title</td>
</tr>
<tr>
<td>---</td>
<td>-------</td>
<td>------</td>
<td>------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>4</td>
<td>11.00</td>
<td>47</td>
<td>Detection of Air Gap Eccentricity On Three-Phase Induction Motor Using 3-Axis Digital ELF Gaussmeter</td>
</tr>
<tr>
<td>5</td>
<td>11.15</td>
<td>106</td>
<td>Influence of Three-Phase Impulses with Different Sequences and Rise Times on Voltage Distribution Along the Stator Winding of Rotating Machines</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>11.30</td>
<td>114</td>
<td>Effect of Jump Voltage and Rise Time on the Temperature and Electric Field Distribution Along the Stress Grading System of An Inverter-fed Motor</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Session theme: Transient Phenomena and Protection

**Time:** 10.15 – 11.45 WIB/UTC+7

**Chair A:** Bryan Denov, ITB

**Chair B:** Mateo Quizhpi Cuesta, Universidad Politecnica Salesiana

**Committee:** Fahmi Nurul Alimi & Ilham Muliawan


<table>
<thead>
<tr>
<th>No.</th>
<th>Time</th>
<th>Paper No.</th>
<th>Title, Author &amp; Institution</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>10.15</td>
<td>4</td>
<td><strong>Tropical Lightning Strike Potential as a Cause of Oil Tank Fire in Indonesia</strong>&lt;br&gt;Farhan Hafiz Budisatrio, Bryan Denov, Suwarno, Syarif Hidayat, Wisnu Adyatma S, Reynaldo Zoro&lt;br&gt;School of Electrical Engineering and Informatics, Bandung Institute of Technology, Bandung Indonesia.</td>
</tr>
<tr>
<td>2</td>
<td>10.30</td>
<td>23</td>
<td><strong>Observed Acoustic Radiation of Thunder Using Microphones Array</strong>&lt;br&gt;Ariadi Hazmi&lt;br&gt;Dept. of Electrical Engineering, Universitas Andalas, Indonesia</td>
</tr>
<tr>
<td>3</td>
<td>10.45</td>
<td>123</td>
<td><strong>Analysis of Corona Characteristics of HVAC and HVDC in a Simulation Environment</strong>&lt;br&gt;Sasindu Thennakoon¹, Dinuka Dilshan², Ruwansi Kaldasani³, Rasara Samarasinghe⁴, Rohan Lucas⁵&lt;br&gt;¹,²,³,⁴ Department of Electrical Engineering, University of Moratuwa, Katubedda, Sri Lanka&lt;br&gt;⁵Department of Electrical, Electronic &amp; Telecom. Engineering, General Sir John Kothalawala Defence University, Rathmalana Sri Lanka</td>
</tr>
<tr>
<td>No</td>
<td>Time</td>
<td>Number</td>
<td>Title</td>
</tr>
<tr>
<td>----</td>
<td>--------</td>
<td>--------</td>
<td>----------------------------------------------------------------------</td>
</tr>
<tr>
<td>4</td>
<td>11.00</td>
<td>121</td>
<td>Analysis of Currents in Dielectric Gloves Due to Medium Voltage Surges</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>11.15</td>
<td>146</td>
<td>Verification and Calibration of Impedance Measuring Instrument</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>11.30</td>
<td>77</td>
<td>A Simulation Study on Lightning Current Distribution in Telecommunication Tower</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
# High Voltage Engineering Session

**Wednesday, 6th October 2021**

**PTS 4-3**

**Session theme**: High Voltage Engineering  
**Time**: 10.15 – 11.45 WIB/UTC+7

**Chair A**: Bambang Anggoro, ITB  
**Chair B**: Rahman Azis Prasojo, ITB

**Committee**: Jean Pierre Uwiringiyimana & Syadilla Refiasto


<table>
<thead>
<tr>
<th>No.</th>
<th>Time</th>
<th>Paper No.</th>
<th>Title, Author &amp; Institution</th>
</tr>
</thead>
</table>
| 1   | 10.15 | 28        | **Development of Overhead Transmission Line Assessment Index**  
Rofiul Huda¹, Rahman Azis Prasojo², Suwarno³, Rizally Priatmadja⁴  
¹,²,³ School of Electrical Engineering & Informatics Institut Teknologi Bandung, Bandung, Indonesia; ⁴Central Java Transmission Central Unit PT PLN (Persero) Bandung, Indonesia. |
| 2   | 10.30 | 43        | **High Voltage Conductor Effect Estimation on The Nearby Buried Piping System**  
Dimas Aji Nugraha, Guntur Supriyadi, Aji Suryo Alam, Joko Hartono, Hakim Habibie Hu  
Transmission and Distribution Dept, PLN Puslitbang Jakarta, Indonesia. |
| 3   | 10.45 | 84        | **A Study on Bending Properties of CTCs in Hot State**  
Shuqi Zhang¹, Zuoxian Wang², Zhengyu Xu³, Na Chai⁴  
¹,²,³China Electric Powe Research Institute, Beijing, China  
⁴Shenyang Hongyuan Magnet Wire Co., Ltd. Shenyang, China |
<table>
<thead>
<tr>
<th>Page</th>
<th>Time</th>
<th>Duration</th>
<th>Title</th>
<th>Authors</th>
<th>Institutions</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>11.00</td>
<td>34</td>
<td><strong>Characterization of Glow Plasma Treatment on Nanosilica Under Different Treatments Time</strong></td>
<td>N. M. Saman¹, M. H. Ahmad², Z. Buntat³, Z. Adzis⁴, Z. Nawawί⁵, M. A. B. Sidik⁶, M. I. Jambak⁷</td>
<td>¹²³⁴Institute of High Voltage and High Current, School of Electrical Engineering, Universiti Teknologi Malaysia, Johor Bahru, Malaysia. ⁵⁶⁷Department of Electrical Engineering, Faculty of Engineering, Universitas Sriwijaya, Ogan Ilir, South Sumatra, Indonesia.</td>
</tr>
<tr>
<td>5</td>
<td>11.15</td>
<td>72</td>
<td><strong>Aging Behavior of Mineral Oil, Gas-to-Liquid (GTL), and Natural Ester Liquids in Presence of Cellulosic Materials</strong></td>
<td>Mawla Ahmad, Ilhamid Daris, Hardiansyah Rahmat, Suwarno School of Electrical Engineering and Informatics Bandung Institute of Technology Bandung, Indonesia.</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>11.30</td>
<td>74</td>
<td><strong>Mitigation of Insulator Ultraviolet Emission Measurement Errors using Facular Area</strong></td>
<td>Tumiran¹, Mochammad Wahyudi², Noor Akhmad Setiawan³, Faiq Arkan Dewanto⁴, Kukuh Pambudi⁵, Dharma Saputra⁵</td>
<td>¹²³⁴Department of Electrical and Information Engineering Universitas Gadjah Mada Yogyakarta, Indonesia ⁵⁶PLTU Jawa Tengah 2 Adipala Indonesia Power Company Cilacap, Indonesia</td>
</tr>
</tbody>
</table>
### Session: Partial Discharge Monitoring

**Time**: 10.15 – 11.45 WIB/UTC+7

**Chair A**: Suwarno, ITB

**Chair B**: Min Chen, ZF Technology Limited

**Committee**: Farradita Nugraha & Taufik Rhamdhani


<table>
<thead>
<tr>
<th>No.</th>
<th>Time</th>
<th>Paper No.</th>
<th>Title, Author &amp; Institution</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>10.15</td>
<td>98</td>
<td>Application of Online PD Monitoring System Based on Large-scale Distributed Detection on High Voltage Cable Line Min Chen¹, Koji Urano², Zhipeng Zhou³, Jingjing Lu⁴, Yingying Liu⁵, Yanting Xie⁶¹.².³.⁴ Technical department SE Technology Limited Hong Kong, China ⁵.⁶ Technical department ZF Technology Limited Guangzhou, China</td>
</tr>
<tr>
<td>2</td>
<td>10.30</td>
<td>86</td>
<td>Partial Discharge Characteristics of Low-Density Polyethylene Nanocomposites Incorporated with Plasma-treated Silica and Boron Nitride Nanofillers N. M. Saman, N. A. Awang, M. H. Ahmad, Z. Buntat, Z. Adzis Institute of High Voltage and High Current, School of Electrical Engineering, Faculty of Engineering, Universiti Teknologi Malaysia, Johor Bahru, Johor, Malaysia</td>
</tr>
<tr>
<td>3</td>
<td>10.45</td>
<td>87</td>
<td>Enhancement of Electrical Treeing and Partial Discharge Characteristics of Silicone Rubber filled with Silicon Nitride Nanoparticles N. M. Saman, A. H. M. Nasib, M. H. Ahmad, Z. Buntat, Z. Adzis, M. A. M. Piah Institute of High Voltage and High Current, School of Electrical Engineering, Faculty of Engineering, Universiti Teknologi Malaysia, Johor Bahru, Johor, Malaysia</td>
</tr>
<tr>
<td></td>
<td>Time</td>
<td>Page</td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>-------</td>
<td>------</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>11.00</td>
<td>85</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Ultra High Frequency Partial Discharge Sensors based on Various Microstrip Patch Antenna Designs</strong>&lt;br&gt;S. Jaruman, N. M. Saman, H. C. Xiang, M. H. Ahmad, Z. Buntat, Z. Adzis&lt;br&gt;Institute of High Voltage and High Current, School of Electrical Engineering, Faculty of Engineering, Universiti Teknologi Malaysia, Johor Bahru, Johor, Malaysia.</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>11.15</td>
<td>159</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Testing New Design Partial Discharge Detector Using Vector Network Analyzer and Charge Calibrator</strong>&lt;br&gt;Umar Khayam, Naufal Hilmi Fauzan&lt;br&gt;School of Electrical Engineering and Informatics, Institut Teknologi Bandung, Bandung, Indonesia</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>11.30</td>
<td>161</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Study of Antenna Development for Partial Discharge Measurement</strong>&lt;br&gt;Umar Khayam, Farradita Nugraha&lt;br&gt;School of Electrical Engineering and Informatics, Institut Teknologi Bandung, Bandung, Indonesia</td>
<td></td>
</tr>
</tbody>
</table>
Wednesday, 6th October 2021
PTS 5-1
Session theme : Power Transformer Diagnostics
Time : 15.25 – 16.25 WIB/UTC+7
Chair A : Abdul Rajab, Andalas University
Chair B : Hary Gumilang, PLN
Committee : Adit Firmansyah & Ari Mukti

<table>
<thead>
<tr>
<th>No.</th>
<th>Time</th>
<th>Paper No.</th>
<th>Title, Author &amp; Institution</th>
</tr>
</thead>
</table>
| 1   | 15.25 | 105       | **Power Transformer Oil Measurement Prioritization based on Technical and Economic Criteria using Analytic Hierarchy Process**
Rahman Azis Prasojo, Heri Sutikno, Suwarno, Nur Ulfa Maulidevi, Bambang Anggoro Soedjarno P.
School of Electrical Engineering and Informatics, Institut Teknologi Bandung, Bandung, Indonesia
PT. PLN (Persero) Bandung, Indonesia |
| 2   | 15.40 | 55        | **Experimental Setup for Ferroresonance Initiation On 3-Phase Low Voltage Transformer**
I Gusti Ngurah Satriyadi Hernanda, I Made Yulistyga Negara, Dimas Anton Asfani, Daniar Fahmi, Naoki Satryo Anggito, Chairul Bahy
Electrical Engineering Department, Sepuluh Nopember Institute of Technology, Surabaya, Indonesia. |
| 3   | 15.55 | 110       | **Early Warning Breakdown Power Cable Transformer XLPE Type with Partial Discharge Testing**
Fabianus Marintis Dwijayatno, Tessamonica Luthfia, Nelson Silaen, Ahadiyat
\(^1\)Substation and GIS Assessment Department PLN UIT JBT, Bandung, Indonesia; \(^2\)Planning and Evaluation Department PLN UIT JBT Bandung, Indonesia |
| 4 | 16.10 | 103 | Design of a Rectangular Microstrip Patch Antenna as UHF Sensor for Partial Discharge Detection on Power Transformer  
Jean Pierre Uwiringiyimana, Suwarno, Umar Khayam  
School of Electrical Engineering, Institut Teknologi Bandung, Bandung, Indonesia |
Wednesday, 6th October 2021

**Session theme:** Power System Protection

**Time:** 15.25 – 16.55 WIB/UTC+7

**Chair A:** Kevin Marojahan Banjar Nahor, ITB

**Chair B:** Rizky Rahmani, ITB

**Committee:** Fahmi Nurul Alimi & Ilham Muliawan


<table>
<thead>
<tr>
<th>No.</th>
<th>Time</th>
<th>Paper No.</th>
<th>Title, Author &amp; Institution</th>
</tr>
</thead>
</table>
| 1   | 15.25 | 164       | **Special Protection System (SPS) Designing and Testing Based on Vulnerability and Frequency Security Index: Case Study Of Batam-Bintan System, Indonesia**  
M. Rivandi Fadli, Kevin Marojahan Banjar Nahor, Nanang Hariyanto, Rizky Rahmani, Fathin Saifur Rahman  
Electrical Power Engineering School of Electrical Engineering and Informatics  
Bandung Institute of Technology  
Bandung, Indonesia |
| 2   | 15.40 | 169       | **Real Time Simulation of New Defense Scheme Based on Centralized Remedial Action Scheme For Batam-Bintan Electrical System Implementation**  
Nuel Yosia, Kevin Marojahan Banjar Nahor, Nanang Hariyanto  
Electrical Power Engineering School of Electrical Engineering and Informatics  
Institut Teknologi Bandung, Bandung, Indonesia |
| 3   | 15.55 | 13        | **Interarea-Oscillation Damping with Dual Power Oscillation Damping Controller of a Utility-Scale Wind Power Plant**  
Mayur Basu, Jinho Kim, Robert M. Nelms, Eduard Muljadi  
Electrical and Computer Engineering  
Auburn University Auburn, USA |
<table>
<thead>
<tr>
<th></th>
<th>Time</th>
<th>Page</th>
<th>Title</th>
<th>Authors</th>
</tr>
</thead>
</table>
| 4 | 16.10 | 115  | Simulation and Prevention of Indonesia Southern-Middle Sumatran West Ring Grid Power Swing Phenomena when Open Looping | Dispriansyah¹, Agustriadi², Agus Trimanto³  
¹Transmission and load control center PT PLN (Persero) P3B Sumatera Pekanbaru, Indonesia  
²Operation System PT PLN (Persero) P3B Sumatera Pekanbaru, Indonesia  
³Transmission Academy PT PLN (Persero) UPDL Semarang Semarang, Indonesia |
| 5 | 16.25 | 166  | Static Security Assessment using Randomforest Based on Digsilent-Phyton Simulation | Eko Agus Murjito, Kevin M. Banjar-Nahor, Rizky Rahmani, Fathin Saifur Rahman, Nanang Hariyanto  
Electrical Power Engineering School of Electrical Engineering and Informatics Bandung Institute of Technology Bandung, Indonesia |
| 6 | 16.40 | 117  | Implementation of Auto Reclose for Combined Overhead Line with Underground Cable using Distance Relays. A case study at Gajah Tunggal 150kV Substation | Hikmah Praseta, Amdi Nopriansyah, Yudha Nugroho  
PT PLN (Persero) UIT Jawa Bagian Barat Jakarta, Indonesia |
Wednesday, 6th October 2021
PTS 5-3
Session theme: Asset Management
Time: 15.25 – 16.40 WIB/UTC+7
Chair A: Fathin Saifur Rahman, ITB
Chair B: Anindita Satria Surya, PLN
Committee: Syadila Refiasto & Adista Dwi Praharti

<table>
<thead>
<tr>
<th>No.</th>
<th>Time</th>
<th>Paper No.</th>
<th>Title, Author &amp; Institution</th>
</tr>
</thead>
</table>
| 1   | 15.25  | 71        | An Overview of Reliability and Power Quality of Distribution Network due to Penetration of Rooftop Photovoltaic System and Plug-in Electric Vehicle  
Dhandis R. Jintaka, K. G. H. Mangunkusumo, Putu Agus Aditya Pramana  
Transmission and Distribution Department PLN Research Institute Jakarta, Indonesia |
| 2   | 15.40  | 18        | Evaluation Of High Voltage Live Working MAD Changes Related To Maintenance And Substation Equipment Design In the Case Study of UPT Tanjung Karang  
Aryo Tiger Wibowo¹, Kurniawan Danu Diharja², Ferry Fadli³, Abdul Fajar⁴  
¹P3B Sumatera PLN Indonesia Pekanbaru, Indonesia ²Divisi PET PLN Indonesia Jakarta, Indonesia ³UPT Tanjung Karang PLN Indonesia Lampung, Indonesia ⁴UPT Pulogadung PLN Indonesia Jakarta, Indonesia |
| 3   | 15.55  | 5         | Improving Transmission Line Maintenance Strategy by Digitizing Maintenance Report Process and Maintenance Data Visualization  
Rizally Priatmadja, Arief Ibrahim Wuller, Rintoko Setyo Wibowo, Ali Rofii, Deni Yanuar Kristiadi, Tejo Wihardiyono |
| 4 | 16.10 | 17 | **Investment Assessment using Monte Carlo Method for Power Grid Project in Jawa-Madura-Bali System**  
Anindita Satria Surya¹, Musa Partahi Marbun², Yehuda Bayu Kristiawan³, Achmad Syerif Habibie⁴  
¹Transmission and Distribution Department PT PLN Research Institute Jakarta, Indonesia ²System Planning Division PT PLN Head Office Jakarta, Indonesia ³Planning and Project Control Department PT PLN Pusat Manajemen Proyek Semarang, Indonesia |
| 5 | 16.25 | 157 | **Network Stress Assessment of Planning Distribution Approach on High Penetrations E-Mobility and DERs**  
Candra Agus Dwi Wahyudi¹ Fathin Saifur Rahman²  
¹Planning Department PT PLN (Persero) Jakarta, Indonesia ²School of Electrical Engineering and Informatics Institut Teknologi Bandung Bandung, Indonesia |
### Wednesday, 6th October 2021

**PTS 5-4**

**Session theme:** Power Quality  
**Time:** 15.25 – 16.55 WIB/UTC+7  
**Chair A:** Deny Hamdani, ITB  
**Chair B:** Dhandis Rito JIntaka, PLN Research Institute  
**Committee:** Farradita Nugraha & Taufik Rhamdhani  

<table>
<thead>
<tr>
<th>No.</th>
<th>Time</th>
<th>Paper No.</th>
<th>Title, Author &amp; Institution</th>
</tr>
</thead>
</table>
| 1   | 15.25| 58        | Power Quality Analysis of Solar PV/Micro-Hydro/Wind Renewable Energy Systems for Isolated Area  
Dwi Sahidin, Tri Desmana Rachmildha, Deny Hamdani  
School of Electrical Engineering and Informatics Institut Teknologi Bandung  
Bandung, Indonesia |
| 2   | 15.40| 46        | An Overview of Reliability and Power Quality of Distribution Network due to Penetration of Rooftop Photovoltaic System and Plug-in Electric Vehicle  
Dhandis R. Jintaka, K. G. H. Mangunkusumo, Putu Agus Aditya Pramana  
Transmission and Distribution Department  
PLN Research Institute Jakarta, Indonesia |
| 3   | 15.55| 67        | A Voltage Rise Mitigation Control Scheme of Utility-Scale Battery in High PV Penetration  
Wijaya Yudha Atmaja, Sarjiya, Lesnanto Multa Putranto  
Department of Electrical and Information Engineering Universitas Gadjah Mada  
Yogyakarta, Indonesia |
<table>
<thead>
<tr>
<th>Time</th>
<th>Page</th>
<th>Session</th>
</tr>
</thead>
</table>
| 16.10 | 130 | Study of Power Quality Problems for Improving The Quality of Electricity in Java: Case Study of East Java Regional Industry Customers with Power Greater Than 30 MVA  
A. S. Habibie, M. Ridwan, D. R. Jintaka  
Ristek TND PLN Research Institute Jakarta, Indonesia |
| 4 | 16.25 | 41 | Backward Forward Sweep Algorithm for Unbalanced Three-Phase Power Flow Analysis in Distribution Systems Containing Voltage Regulator  
Taqiyuddin, Suwarno, Gibson H. M. Sianipar, Muhammad Nurdin  
School of Electrical Engineering and Informatics Institute of Technology Bandung Bandung, Indonesia |
| 5 | 16.40 | 60 | Performance Analysis of Offshore Floating PV Systems in Isolated Area  
Radhiansyah, Tri Desmana Rachmilda, Deny Hamdani  
School of Electrical Engineering and Informatics Institut Teknologi Bandung Bandung, Indonesia |
Plenary Session 1-1:

**Eduard Mulyadi**
Auburn University, US
Renewable Energy Deployment for a Large Scale System Integration and Microgrids

**Abstract:** This presentation describes renewable energy deployment in the context of large scale integration and microgrids power systems. This topic is intended to find the options available for renewable energy integration in Indonesia. Opportunities and challenges integrating renewables in a large archipelago nation with more than 17,000 islands and different types and levels of power systems readiness and grid strengths.
Plenary Session 1-2:

**Pekik Argo Dahono**
ITB, Indonesia

New Family of Voltage Source Converters Derived Using New Basic Cell for Microgrid Applications

**Abstract:** A new family of voltage-source inverters for microgrid applications is proposed in this paper. The proposed voltage-source inverters are constructed by using a new basic cell that is called modified dc-dc power converter. By using the proposed basic cell, the obtained voltage-source converters have very small input and output ripples with efficiency higher than the conventional ones. The concept is then extended to modular multilevel voltage-source converters. The obtained multilevel converters have very small input and output ripples with self-voltage balancing capability. Conventional control methods that have been developed for conventional voltagesource inverters can be applied directly to the proposed voltage-source inverters. Several simulated and experimental results are included here to show the basic performance of the proposed converters.
Plenary Session 1-3:

Masayuki Hikita
Kyushu Institute of Technology, Japan
Research Trends in Online Partial Discharge Monitoring and Diagnosis Utilizing ICT in Electric Power Equipment

Abstract: This article introduces the latest research trends in insulation diagnosis by PD detection that the authors have conducted. In particular, online partial discharge (PD) detection, monitoring and diagnosis technology are explained regarding the application status of online diagnosis, which are strongly requested to be applied in the field from the viewpoint of early action and cost reduction. The article also presents simulation techniques for understanding and visualization of electromagnetic wave propagation caused by PD phenomena. In addition, an online PD monitoring system (PLC-PDMS) using information and communication technology (ICT) is introduced.
Abstract: Insulation plays an important role in power system. During the production and operation of power equipment, there will inevitably be insulation defects occurring. Realizing the detection and localization of these defects is of great significance to ensure the safe and stable operation of power system. In this paper, different defect localization algorithms are proposed for transformer, cable and whole substation equipment, respectively. Experimental results show that these algorithms can reach a high localization accuracy.
Plenary Session 1-5:

**Tumiran**  
UGM, Indonesia  
Potential of Biomass as RE Source for Sustainable Electricity Supply in Eastern Indonesia

**Abstract:** Indonesia is working hard to fulfill the quantity, quality, and reliability of the electricity supply in eastern Indonesia. The geographical condition of eastern Indonesia, which consists of thousands of islands with a scattered population and relatively low density, makes it challenging to electrify this region economically. This region still relies on fossil fuels to produce electricity. This dependency becomes a primary problem due to cost production, security of fossil supply, and not being environmentally friendly. An option to reduce fossil fuels dependency and ensure the sustainability of electricity supply and reach the economic production cost is to replace fossil energy with renewable energy (RE) sources. However, no research in this area focuses on finding the most economical and sustainable RE sources. Therefore, this research focuses on finding RE sources based on local energy resources, guaranteeing sustainability, supporting local economic growth, and operating at a reasonable cost. The research's results show that the biomass sources potential in eastern Indonesia is immense, distributed over a vast area. The projected electricity demand in Eastern Indonesia towards 2050 will reach 15.9 TWh, and it needs to be supported by more than 4,200 MW of generating capacity. Suppose it is targeted that by 2050 electrical energy from RE will reach 31%. In that case, it is projected that the aggregate biomass required will reach 5.86 million tons, with the average conversion of wood biomass to produce calories ranging from 4,200 to 4,600 kcal/kg. The volume of forest products will supply the Biomass power plant to reach 1.28 GW. These potential needs can be met by energy plantations covering 1,130,738 ha spread across various islands in Eastern Indonesia. In addition, the sustainable preparation of biomass forests will also drive people's economy in this region.
Plenary Session 2-1:

M.V. Reddy
Research Hydro-Québec, Canada

Advances in High voltage Materials for high power electric vehicles, grids for a sustainable environment

Abstract: Lithium-ion batteries (LIBs) are used in present-day portable electronic devices, electric/hybrid electric vehicles, power Grid and back-up power supplies. Further, LIBs need to satisfy several criteria, namely, cost-reduction, improvement in energy density, safety-in-operation at high current rates, and improvement in the low-temperature operation. To satisfy the above criteria, research is being carried out worldwide to find alternative novel electrode materials for metal-ion batteries, improved the performance by various materials synthesis, surface modification, fabrication technology and also thermal and power management.

In my talk, I will discuss my studies fundamentals of High energy and power density of materials for electric vehicles and power grides, on novel metal electrode materials related to high power batteries. Specifically, I will focus on materials, such as Li/NaMPO$_4$F (M= V, Fe), novel V-based metal-organic framework materials oxalato Phosphate, Phosphite cathodes, Mo-metal clusters, and Sn-based hollandties and Sn-Pyrochlore type structure, metal fluorides and oxyfluorides, Nano-M N, O (M=Co,Ni, Cu, Mn) and sulfide & oxide solid electrolytes, materials synthesis, characterization techniques, fundamentals, interface studies and applications related to energy storage. Various preparation methods and surface coating techniques. Prepared materials were characterized by Rietveld refinement X-ray diffraction, Neutron diffraction, Rutherford backscattering spectrometry (RBS), Nuclear reaction (NRA), AES, X-ray absorption/photoelectron spectroscopy (XAS/XPS), SEM, TEM, Raman/IR, density and BET surface area methods. Electrode fabrication and various fast charging, electrochemical impedance spectroscopy, GITT, PITT techniques for Li,Na,K -ion batteries, and in situ and ex-situ studies, reaction mechanisms, and voltage hysteresis, materials environmental sustainability and present challenges on Li/Na -ion batteries will be discussed.
Plenary Session 2-2:

Udaya K. Madawala
The University of Auckland New Zealand
EV Charging: Challenges and Solutions

Abstract: Electric vehicles (EVs) reduce air pollution and global warming, and are ideal for sustainable living. However, the high uptake of EVs also poses some technical challenges. These include the necessity for increased levels of EV charging infrastructure and the demand-side issues associated with charging infrastructure planning and services. In addition, grid impacts due to large-scale charging demands also compromise the stable and economic operation of the power grid. Thus to mitigate grid impacts and overcome demand-issues, it is crucial to deploy charging infrastructure strategically and operate charging services properly. This seminar discusses these challenges, clarifying the technical problems, and presents the solutions that have been proposed. The seminar concludes with new research directions in this area to promote further research.
Abstract: The electricity company is an asset-intensive business that relies on the performance of the assets. Understanding the risks of assets is therefore essential to support the decision-making process and ensure the achievement of the company's strategic goals. In an integrated electricity company, like in PLN Indonesia, having a standardized measure on asset risk is vital to align the varying views on risks within the organization. The alignment demands clear definitions and requirements from different stakeholders and the agreement on the definition and the estimation of the asset's likelihood of failure. This paper provides an approach for quantifying the risk of asset failure in a power system business. The approach fundamentally derives the stakeholders' requirements into quantified parameters and standardizes the definition of probability of failure. An example is provided with the implementation in the Jawa-Bali regional business of PLN.
Plenary Session 2-4:

**N. Pattanadech**

KMITL, Thailand

Application of Polarization and Depolarization Current Measurement for Rotating Machine Insulation Analysis

**Abstract:** Rotating machine is a vital asset of the power plants. For the motors and generators in service, the stator winding insulation is generally operated under thermal, electrical, ambient, and mechanical stresses. The combination of these stresses causes insulation degradation that can lead to early aging or severe damage and, finally, the failure of such machines. The failure of rotating machines may result in immense financial loss and other aspects. Polarization and depolarization current (PDC) measurement has been introduced as one of the time-domain dielectric spectroscopy test techniques applied for insulation condition testing. This paper represents the application of PDC measurement to evaluate the insulation for the stator bars/coil insulation experienced with various kinds of stresses. Moreover, the PDC field test of generators and high voltage motors used in the power plants is introduced. From the experiments, the dielectric parameters obtained from PDC measurements are clearly useful parameters to evaluate the electrical insulation of such rotating machines.
Plenary Session 2-5:

Suwarno
ITB, Indonesia
Understanding of Outdoor Insulator Characteristics through Leakage Current and Electrical Equivalent Circuit

Abstract: Outdoor insulator is one of the important equipment in an electrical power system. The failure of the isolator, especially in the form of flashover, contributes significantly to the total system failure. In order to improve the performance of the outdoor insulator, a number of efforts have been made, such as the use of new materials, surface coatings to improve dielectric strength and improvement of insulator design. Systematic efforts to improve insulator performance require an understanding of insulator behavior. This paper describes how to understand the behavior of an insulator by using an electrical equivalent circuit derived from the leakage current waveform. Using the proposed equivalent circuit, the leakage current wave simulation was carried out for ceramic and silicone rubber insulators under clean fog and salt fog conditions. Information about insulator parameters such as resistant, non-linearity property and arc that can be obtained from simulation are important to improve the performances of the insulators.
Plenary Session 3-1:

A. Abu-Siada
Curtin University, Australia
An Effective Damping Control Scheme to Improve Inter-Area Power System Stability

Abstract: In a large and complex interconnected power system with long transmission lines, the inadequate damping scheme for the inter-area oscillations may lead to system instability. This issue is commonly solved by employing a power system stabilizer (PSS) to increase the system damping. However, the use of PSS encounters some limitations that include voltage fluctuation and poor performance in damping significant oscillations that result due to three-phase faults. To improve the damping of the inter-area oscillation modes, a unified power flow controller (UPFC) along with the PSS is proposed in this paper. Simultaneous utilization of PSS and UPFC calls for proper coordination to attain an optimal damping performance. Hence, a method to obtain optimal coordination between the PSS and UPFC by employing the Firefly algorithm is proposed. To verify the effectiveness of the proposed method, the performance of the proposed damping scheme is analyzed through simulation analysis. Simulation results show the effectiveness of the proposed method in damping low as well as large oscillations in the power systems.
Abstract: This paper deals with the challenges and perspectives for the 2nd edition of the IEC 60034-18-41. The stress imposed by wide bandgap inverters on the turn insulation will be discussed as well as the differences in the behavior of PDIV as a function of thermal aging when tested using 50/60 Hz AC voltage waveforms or SiC impulse voltages. Consideration for the application of this document to the field of traction electrification will also be discussed.
Plenary Session 3-3:

**Gilbert Teyssedre**
CNRS and University Paul Sabatier, France
Charge Trap Spectroscopies in Polymer Dielectrics: Application to BOPP

**Abstract:** Polymer dielectrics are in use in a variety of applications in active or passive electrical components. Their propensity to store electrical charges is used e.g. to form electrets but is a drawback when insulation properties are looked for. It is therefore essential to investigate the traps characteristic for a given material because trapping phenomena control the transport properties and therefore the field distribution. Different trap spectroscopies are available to infer the nature of traps, their energy depth and their amount. In the first part of this communication, we briefly review the different methods for traps characterization, emphasizing on strength and weaknesses of the methods. In a second part, results obtained on bioriented polypropylene are used to illustrate the difference in trap depth estimation obtained using thermal and optical excitation to release charges from traps. The differences are discussed with introducing results from luminescence induced by charge recombination.
Plenary Session 3-4:
**Nanang Hariyanto**
ITB, Indonesia
Maximum Penetration of VRE in to Grid
Plenary Session 3-5:

**R. Sarathi**

Indian Institute of Technology Madras, India

Influence of Corona Ageing on Electrical and Mechanical behaviour of Epoxy Micro-Nanocomposites

**Abstract:** Epoxy micro-nanocomposites prepared with addition of silica micro-particles and IXEPLAS® nanofillers are exposed to corona phenomenon for different durations to understand its impact on the electrical as well as mechanical properties. Corona inception voltage (CIV) due to water droplets has been determined by adopting UHF and fluorescence techniques. The CIV values tend to reduce significantly after corona ageing. Surface potential decay analysis showed slight decrement in initial surface potential and increased rate of surface potential decay. Reduction in trap depth at peak value of trap density is observed with increment in corona ageing period. From atomic force microscopy (AFM) analysis, significant raise in mean surface roughness is noticed with respect to corona ageing period. Reduction in activation energy and glass transition temperature are noticed with increment in corona ageing period, from dynamic mechanical analysis (DMA).
Study on Equivalent Circuit of Epoxy Resin Insulators based on Leakage Current Waveforms Under Clean Fog Conditions

Adjie Bagaskara, Suwarno
School of Electrical Engineering and Informatics, Institut Teknologi Bandung, Bandung, Indonesia

Abstract: This paper describes the equivalent circuit parameters of epoxy resin polymer insulators based on leakage current under clean fog conditions. Equivalent circuit parameters for the insulator were determined based on the leakage current through a simulation using the ATPDraw software. The simulation is carried out by iteratively entering the leakage current equivalent circuit parameters which are Suwarno’s model and arc’s model so that the leakage current parameters from the simulation circuit are the same or close to the leakage current results from the experimental results. The validated leakage current parameters are the magnitude, waveform, and harmonic components. The results show that changes in the test voltage and humidity affect the leakage current equivalent circuit parameters in the insulator which is the non-linear resistance of the insulator’s surface. Meanwhile, other component parameters are also affected by changes in humidity and voltage test although not too large. The number of arc model required is also affected by the humidity and the test voltage applied to the epoxy resin insulator.
Study of Leakage Current Characteristics of High Voltage Insulators Ageing After Dry Season in Polluted Environmental Conditions
Salama Manjang, Syafaruddin, Tambi, Ikhlas Kitta, Mustarum Musaruddin
Department of Electrical Engineering Hasanuddin University Makassar, Indonesia. Department of Electrical Engineering, Halu Oleo University Kendari, Indonesia

Abstract: This paper aims to study the leakage current characteristics of outdoor insulators exposed to pollution after a long dry season. This study observed the insulating phenomenon using the natural tropical climate of the Gowa Makassar region in Indonesia and the effect of NSDD, humidity, temperature, ultraviolet light, and rainfall in real-time. A microcontroller was used to collect data on leakage current and environmental-climate conditions over 23 months. Silicon rubber-type line posts and suspensions were used in the test sample, mounted on a 20 kV distribution network. The illustration of this test can represent actual conditions in the field. This leakage current test refers to the IEC 60060 standard with a real-time monitoring system for leakage current and tropical climatic conditions. For hydrophobic measurements using the spray method according to IEC 62073 and STRI 92/1 standards. The tests show that the leakage current and hydrophobic properties are influenced by changes in the tropical climate with temperature, humidity, ultraviolet radiation, and rainfall parameters. Changes in hydrophobic properties are also controlled by the mechanism for cleaning pollutants during rain and experiencing recovery when climatic conditions return to normal due to the hydrophobic transfer of contaminants. In addition, laboratory-based flashover mechanism testing was also carried out to determine the reliability of the insulator. This test demonstrates that the flashover voltage is affected by the number of pollutants and wetting on the silicone rubber polymer insulator's surface.
Effect of Artificial Aging on Silicone Rubber Polymeric Insulator Performance at Various Environmental Conditions
Adib Akbar Jaelani, Shafa Nabila Haya, Suwarno, Lunnetta Safura L. School of Electrical and Informatics Engineering Bandung Institute of Technology Ganeca St. 10, Bandung, 40132, Indonesia

Abstract: Silicone rubber polymeric insulator is one type of insulator that has great hydrophobicity compared to conventional insulators, but its damage by environmental conditions like UV irradiation, pollution and humidity of air. Natural aging takes a long time, so in this study artificial aging will be carried out to accelerate natural aging to know its condition and performance after that. One of artificial aging are pollution exposure, NSDD is value of pollution exposure in artificial aging which cover variation of natural pollution. There are several parameters would be observed like dielectric characteristics (resistance, leakage current characteristics and flashover voltage), hydrophobicity, micro physical (material composition and chemical bonds) in insulators, artificial aging and this test follows IEC, ISO, ANSI and STRI standards, this research was conducted at several laboratory on ITB. The results stated if artificial aging and variations of NSDD value affect the condition and performance of insulator in various environmental conditions. Insulators with artificial aging have a higher number of pollutants and higher exposure to UV radiation, so the physical condition, dielectricity, hydrophobicity, micro physical condition and chemical structure are worse than virgin insulators. Based on this study UV radiation is more damaging than the presence of pollutants.
Effects of UV Radiation and Contaminant on The Properties of Polymeric Insulator
Muhammad Ridhwan, Lunetta Safura Lumba, Suwarno
School of Electrical Engineering and Informatics, Institut Teknologi Bandung, Bandung, Indonesia

Abstract: The frequency of ceramic insulator failures is relatively high, especially in severely polluted areas. Due to superiority in repelling contaminated pollution, polymeric insulators are set to replace ceramic insulators. This research investigated the effects of aging due to ultraviolet radiation, humidity, and contaminant of the polymeric insulators for virgin and aged samples. The applied condition for the samples consist of clean fog without kaolin, clean fog with kaolin, salt fog without kaolin, and salt fog with kaolin, according to IEC 60507. In this research, some samples were put in a chamber and exposed to ultraviolet radiation by UV lamps, and penetrated in a contaminant solution vessel according to ANSI C-29 13-2000. The electrical properties and changes on the surface were investigated by measuring leakage current and total harmonic distortion (THD). Thermal Resistance of samples was investigated by using TG/DTA analysis. The hydrophobicity class of virgin and aging samples was investigated by measuring contact angle based on IEC 62073:2016. Surface morphological degradation and material composition were assessed by Scanning Electron Microscopy (SEM) and Energy Dispersive X-ray (EDX). Experimental results concluded that aging and contaminant significantly affect the aging of the insulators. Due to the pollutant contamination, the surface has a rougher texture, resulting in reduced hydrophobicity ability. The reduction causes conductive currents to flow over the insulators' surface. Due to the aging process, silicone content decreases, but oxygen and carbon increase. Increasing oxygen is caused by oxidation due to UV radiation and corona activity.
Accelerated Aging Study on Silicone Rubber Insulator with Contaminant Level and Fog Conductivity Variations

Shafa Nabilla Haya, Adib Akbar Jaelani, Lunnetta Safura Lumba, Suwarno
School of Electrical Engineering and Informatics, Institut Teknologi Bandung, Bandung, Indonesia

Abstract: Polymeric insulators are widely used in transmission and distribution system in highly polluted areas due to great performance of hydrophobicity. However, further studies are needed to determine the degree of aging and degradation due to electrical and environmental stress to improve insulators’ quality. This paper examines the effects of accelerated aging and contamination on 20 kV line post polymeric insulators performance under various environmental conditions in the tropical region according to IEC 60507. The accelerated aging was conducted in 1000 hours period of UV exposure and immersion process according to ANSI C29-13 2018. Furthermore, kaolin and NaCl were used as daily contaminants respectively for non-soluble and soluble pollutions. Contaminant levels here were varied based on NSDD value. The experiments found that the higher the contaminant level and the conductivity of the fog, the RMS value of leakage current could reach three times higher. The surface conditions of the insulators were also affected by the decrease in the hydrophobicity class from class one to class three. Based on SEM/EDX result, the higher the contaminant level, the rougher surface it would be and it also could be explained with the increase of the Al/Si ratio from 0.54 to 0.96.
Enhancing the Power and Efficiency of Photovoltaic Panel Using Heat Sinks with fans

Zaid Khudhur Hussein¹, Jenan Ayad², Hanan j. Abdulkareem³ Hadi Jameel Hadi⁴
¹,³Medical Instrumentation Technical Engineering Al-Esraa University College Baghdad, ²Iraq Computer Technology Engineering Al-Esraa University College) Baghdad, Iraq ⁴Electrical Engineering Department Oil Products Distribution Company Baghdad, Iraq

Abstract: With its tremendous environmental and economic potential, the renewable-energy sector is quickly gaining traction as a new growth area for many countries. Solar energy is an essential primary energy source, particularly in rural areas. In recent years, solar panels have become increasingly popular for converting solar energy to electrical energy. In this work, a new passive cooling system arrangement was planned and design. It is made up of a two identical heat sink made with four DC fans which is attached with the back part of the solar cell in order for improving the solar cell’s power efficiency by providing suitable cooling conditions. The system will consist of Temperate sensor, ATmega328P microcontroller (Arduino Nano), Heat sink, Fan, and a solar Panel (5.5v). The results showed that is the solar the temperature of the cell decreased in average output from 41.45T to 39.37 T with enhancements about 5 C % with using passive cooling system. The cooling causes to increase the average output current from 0.388 A and 0.428A with enhancements about 9.34 % for the gained current. The cooling causes to increase the average output voltage from 18.52v to 19.92v with enhancements about 7.03% for the gained voltage. The cooling causes to increase the average output power from 7.22W to 8.56W with enhancements about 13.34 % for the gained current. The cooling causes to increase efficiency with enhancements about 11% which is a good ratio that when using the cooling system.
Design A Low-cost PV Performance Ratio Data Monitoring

Yuli Astriani, Dionysius A. Renata, Khotimatul Fauziah, Asih Kurniasari, Hafsah Halidah, Riza
National Laboratory for Energy Conversion Technology, BPPT
Tangerang Selatan, Indonesia

Abstract: Photovoltaic (PV) system’s performance ratio (PR) is used to measure the quality and performance of a PV system. The PR trend can be used to analyze whether a problem occurs in the system. With the advanced development of information and communication technology; nowadays, it is possible to build a real-time PR monitoring system. This paper explicates the design process of a low-cost PV plant’s data monitoring and its PR calculation using free open-access applications whilst following the guidelines on the International Standard IEC 61724. The in-plane solar irradiation and inverter’s daily AC yield energy data are retrieved using Node-red application and are stored in an MySQL database. Using MySQL query commands, the PR values are calculated from the measured data which then are displayed to a web-based application that is programmed using the Grafana application. In this paper, the considered PV system is a 10600 W PV rooftop with a 10kW grid-tied inverter.
Hourly Day-ahead Solar Energy Prediction For Supporting Smart Grid Implementation in Semau Island
Ignatius Rendroyoko¹, Hugo Hadi Suhana², Yvon Besanger³
¹School of Electrical Engineering and Informatics Institut Teknologi Bandung Bandung, Indonesia, PT. Icon+ Jakarta, Indonesia ²Electrical Engineering, Trisakti University, PT. Icon+ Jakarta, Indonesia ³Univ. Grenoble Alpes, CNRS, Grenoble, INP, Grenoble, France

Abstract: Knowledge of solar power prediction is an important aspect for power generation planning as well as supporting operations in grid area that apply photovoltaic (PV) generators. Such an aspect is even more critical in the case of limited availability of measurement data. This paper presents a novel model for predicting daily specific solar radiation using predetermined artificial neural networks. Daily meteorological data are used to enrich the conventional artificial neural networks technique. For simulation purposes, solar data was collected at two locations with different meteorological conditions, namely Kupang, Timor Island and Waingapu, Sumba Island, both in East Nusa Tenggara province, Indonesia. Finally, the proposed method shows good performance so as to achieve the above mentioned prediction purposes.
Analysis of Thermal Storage Temperature Control for Solar Thermal Power Plant
Fauzi Handy Dewanto, Burhanuddin Halimi
School of Electrical and Informatic, Institut Teknologi Bandung
Bandung, Indonesia

Abstract: Utilization of new and renewable energy sources is currently one of Indonesia's intensified agendas, especially for increasing the electrification ratio and providing green power generations. As the equator line crossing country, Indonesia has abundant solar irradiation throughout the year. This potential makes solar energy as emerging alternative for accomplishing these programs. This paper proposes a temperature-based control mechanism for the thermal energy storage of solar thermal power plant that uses Rankine cycle. The solar thermal power plant is set for based-load power generation. As the system model, a commercial power plant and a typical parabolic through set are adopted for verifying the proposed concept by using Ebsilon Pro 15. The results show that the proposed mechanism can perform better in reduced (33%) storage capacity requirement and more constant power output than the conventional control mechanism.
PTS 1-2-5
129

**Design of Defense Scheme Based on Adaptive Under Frequency Load Shedding (AUFLS) at Lombok Island Grid System**

Dede Rilwan Alwaini, Hasna Satya Dini
Faculty of Electricity and Renewable Energy, Institut Teknologi PLN Jakarta, Indonesia

**Abstract:** Electrical system collapse due to highly imbalance load and generation shall be prevented. Load shedding could be an effective solution to prevent system blackout caused by this imbalance load and generation. The approach that commonly used for load shedding design is based on priority scale, which can be ineffective to bring back the system’s frequency and voltage into the allowable range. This paper proposed Adaptive Under Frequency Load Shedding (AUFLS) scheme based on the rate of change of frequency (ROCOF) to be implemented in Lombok Island Grid Defense Scheme. Rate of change of frequency become the basis for determining the amount of load that shall be shed and the voltage sensitivity rank which bus will shed more load. This algorithm is tested by tripping two biggest generator in this grid, Jerancang #1 (22 MW) and Jeranjang #3 (22 MW). Using this scheme, the Lombok grid could reach stable state in 33.08 s at 49.988 Hz. Hence, it can be concluded that AUFLS can be an alternative scheme for designing automatic load shedding at Lombok Island Grid System.
Characteristics of Dissolved Gas Evolution Rate Under Different Loading Factors
Heri Sutikno¹, Rahman Azis Prasojo², Suwarno³
¹Human Talent Development Department, PT PLN (Persero) Jakarta, Indonesia. ²Department of Electrical Engineering Politeknik Negeri Malang, Indonesia. ³School of Electrical Engineering and Informatics, Institut Teknologi Bandung Bandung, Indonesia

Abstract: Dissolved Gas Analysis (DGA) is the most impactful technique for detecting gas abnormalities in transformer insulating oil due to thermal and electrical stresses encountered during transformer operation. The interpretation of DGA results is critical. IEEE C57.104 is a global standard for extracting knowledge from the DGA results. This standard has been modified numerous times in 1991, 2008, and most recently in 2019. The latest standard of IEEE C57.104-2019 shows significant revisions to the previous one. The most significant amendment to this standard is the addition of dissolved gas evolution rate as a reference value for detecting abnormal power transformer operation behavior. The loading factor of a power transformer is indicating its operating characteristics and is a critical factor in determining the insulation reliability of the transformer. Managing proper load distribution for power transformers based on their DGA status may be able to help keep them healthy. Therefore, a field study is conducted to determine the effect of the loading factor on the rate of dissolved gas change. The final result shows the correlation between the loading factor and the dissolved gas concentration yearly rate of increase. Additionally, the correlation between the loading factor and the age of the transformer is more visible in older transformers than in younger transformers.
Finite Element Analysis of Electric Field Distribution in C4F7N as an Alternative to SF6 for Electrical Insulation

Rizwan Ahmad¹, Rahisham Abd Rahman², Ali Ahmed Salem³, Nor Akmal Mohd Jamail⁴, Azhan Ab Rahman⁵, Hafisoh Abdul Ahmad⁶

¹,²,⁴Department of Electrical Power Engineering, Universiti Tun Hussein Onn Malaysia ³Institute of High Voltage and High Current, Universiti Teknologi Malaysia, Skudai Johor ⁵Faculty of Electrical and Electronic Engineering Technology, Universiti Teknikal Malaysia, Melaka ⁶School of Electrical System, Universiti Malaysia Perlis Arau, Malaysia

Abstract: This research work examines the effect of the electric field in C4F7N for different configurations of electrodes and applied voltages. The behavior of the insulation medium is better understood by its electric field analysis. Sphere-sphere and plate-plate electrode configurations are analyzed with varying gap distances. A thorough electric field strength distribution analysis was carried out in a simulation tool based on the finite element method. The electric field strength is firmly dependent on the air gap between the electrodes and applied voltages. The electrodes configuration also affects the electric field and hence the breakdown strength of insulation gas.
Design and Implementation of Experimental Setup for Measurement of Partial Discharge on GIS
Arpan Zaeni, Burhanuddin Halimi, Umar Khayam, Suwarno
School of Electrical Engineering and Informatics, Institut Teknologi Bandung, Bandung, Indonesia.

Abstract: GIS is one of the important equipment that is currently used widely in electric power systems considering its advantages in terms of operational reliability, security, and minimum land use. Such as another high-voltage equipment, the insulating medium in a GIS can degrade which can be diagnosed by the presence of partial discharges. Therefore, a lot of research has been done regarding the phenomenon of PD in GIS, either through simulation or experiment. However, there is one thing that becomes an important issue in GIS experimental research, which is related to the experimental costs which are relatively more expensive than PD experiments on air insulation. This is because the PD experiment in the GIS, there will be some removal of SF6 from inside the GIS model to environment for give some handling, such as the installation of electrodes in the GIS. In this study, an experimental PD testing system in GIS was created by creating a gas inlet outlet system for the GIS tube model with a temporary gas storage feature so that the amount of wasted SF6 would be minimized. The inlet outlet system is made by varying the path so that the tubes can be used to complement each other. After the system is created, the identification of the internal UHF sensors is then carried out. The PD experiment id carried out using internal sensor and TEV as comparison
Determination of Insulating Properties of SO2 gas from BOLSIG+ Calculated Swarm Transport Coefficients

Akhilesh Kumar Pandey¹, Pushpendra Singh², Mohd. Shahnawaz Khan³, Jitendra Kumar Singh⁴
¹,²,⁴Dept of Electrical Engineering, Institute of Engineering & Technology J K Lakshmipat University, Jaipur India
³Dept of Chemistry, Institute of Engineering & Technology J K Lakshmipat University Jaipur India

Abstract: In this paper, the Transport Coefficient of SO₂ gas are calculated from swarm model design using BOLSIG+ which is user-friendly open-source computer program based on numerical solution of Boltzman equation (BE) up to two-term approximations. To ensure close agreement of calculated transport coefficients for SO₂ gas with impending experimental works, first we calculate these coefficients for SF₆, and CO₂ compared the results with reported values. Reasonable agreement is found between calculated and report transport coefficients. For realistic acceptance of SO₂ gas as SF₆ alternative in long-term for high voltage applications, we discussed the utilization of these coefficients in study of various electrical breakdown related phenomenon to understand its dielectric and electrical insulating behavior during electrostatic discharge. We also predict numerical values of insulating properties in uniform electric field under steady state conditions such as electric strength, breakdown voltage and ionization constant for SO₂ gas using transport coefficients. For SO₂ gas, some of these properties and values are being calculated for first time.
Effects of Notches in GIS Spacer Design to Hold Conductor Rods on Electric Field Distribution
Muhammad R. Fabio, Syarif Hidayat, Umar Khayam
Department of Electrical Power Engineering, School of Electrical Engineering and Informatics, Institut Teknologi Bandung, Bandung, Indonesia.

Abstract: This paper discusses the effects of notches in spacers of gas insulated switchgear (GIS) to hold conductor rod to prevent it from sliding down prior to installation. The spacers in question use epoxy resins as its main material with relative permittivity of 3.5. This paper compares the design of spacers without any notches and spacers with 3 notches in its conductor cavity. The results of this paper suggest that spacer with notches has higher electric field intensity compared to spacer without notches. Spacers with notches has maximum electric field intensity of 53.61 KV/cm while the spacers without notches has maximum electric field intensity of 27.84 KV/cm.

Tumiran¹, Sarjiya², Lesnanto Multa Putranto³, Edwin Nugraha Putra⁴, Rizki Firmansyah Setya Budi⁵, Candra Febri Nugraha⁶

¹,²,³,⁵,⁶Department of Electrical and Information Engineering Universitas Gadjah Mada Yogyakarta, Indonesia
⁴System Planning Division PT PLN (Persero) Jakarta, Indonesia

Abstract: A generation and transmission expansion planning (G&TEP) is crucial to obtain economical, reliable, and sustainable power supply. Several factors, including renewable energy policy, archipelago country, uneven distribution of demand and energy resources, and remote areas, increase the complexity of G&TEP problems. Therefore, a G&TEP model by considering these factors is required. This study developed a G&TEP model by taking renewable energy policy and local energy resources into account. This model was implemented in the Jayapura power system to represent a system that is experiencing the aforementioned issues. In addition, the electricity generation in Jayapura is still dominated by high-cost diesel fuel. The research results show that the economical, reliable, and sustainable power supply in Jayapura can be achieved. The optimal result provides a generation cost of 8.4 cents USD/kWh. The renewable energy mix increases from 23% in 2025 to 60% in 2050. Biomass power plants, which utilize local energy sources, contribute the most to the renewable energy share. In addition, the expansion of the transmission line is 385.6 circuit kilometers long and is dominated by 70 kV lines. Furthermore, the 11 existing substations are expanded, and five new substations are built.
Optimized Allocation of Solar PV in Batam-Bintan Power System 2021-2025
Devni Syafrianto, Kevin Marojahan Banjar-Nahor, Nanang Hariyanto
School of Electrical Engineering & Informatics Institut Teknologi Bandung Bandung, Indonesia

Abstract: PLN Batam targeted to achieve 23% of renewable energy mix in 2025. However, PLN Batam only schedules 3x10 MW undefined renewable energy power plant in 2025 through to three connected substations: Sei Harapan, Nagoya, and Panaran in 2025. This condition encourages to conduct maximum renewable energy penetration assessment. Refer to solar potency in Batam-Bintan and global capital cost trend, this paper justifies optimized allocation for solar photovoltaic (PV) in Batam-Bintan 2021-2025 from three consideration aspects: electric, finance and geographic. This paper calculates that 654 MW-minimum midday load in Batam-Bintan 2025 then elaborated with 322 MW as Technical Minimum Loading (TML) system. Thus, maximum solar PV penetration capacity defined as 332 MW. Furthermore, since system strength of Batam-Bintan 2025 about 36 MW and grid code requires normal operation frequency range within 50±0.2 Hz, maximum capacity for one solar PV power plant about 7 MW. Then, Batam-Bintan geographical condition deliver 3 substations that deal with two adjacent solar PV power plants at 12 km. Therefore, frequency and geographic consideration obtain 3x7 MW as optimized capacity from connected substations: Batu Besar, Sri Bintan, and Kijang. Cost optimization using HOMER software then clarifies that 21 MW solar PV in 2025 may produces cost saving $ 2.7 million. Subsequently, grid impact analysis justifies that 21 MW installed capacity in 2025 that deliver no issue. Finally, this paper proposes different solar PV allocation from RUPTL PLN Batam. The difference as product of cascading stages that projected to be novelty in renewable energy penetration assessment.
Micro-Spatial Electricity Planning in Urban Area Based on Energy Demand
Oktaria Handayani¹, Adri Senen², Christine Widyastuti³, Dian Yayan Sukma⁴
¹,²,³Department of Electrical Engineering Institut Teknologi PLN Jakarta, Indonesia ⁴Department of Electrical Engineering Universitas Riau Pekanbaru, Indonesia

Abstract: Electricity infrastructure in the urban area is challenged by the rapid energy demand despite limited area, area density, and dynamic changes in land use. Electricity planning needs to be developed for the correct target and carry out the aspects of quality, efficiency, and continuity. The current planning of electricity is using top to down approach for energy demand forecasting, which generates a macro-based result. However, sectoral energy demand forecasting is unable to locate electrical substations accurately. The problem is worsened by the rapid development in the area. This research conducted micro-spatial electricity planning, in which classifying districts into grids and elaborating energy demand from the smallest grid(district) to the wider area (cities/regencies). The results of forecasting were taken as the references in determining the standard of distribution network design. It includes the calculation of transformer rating and capacity, a total of distribution substations, and a total of substations by referring to the existing condition and area development. Accordingly, the result of electricity planning in urban area is more accurate, detail, and right on target.
Thermal Valorization of the LED by a Thermoelectric Generator

Ahlem Ben Halima¹ Zouhour Araoud² Laurent Canale³ Kamel Charrada⁴ Georges Zissis⁵
¹,²,⁴Research Unit of Ionized and Reactive Media (EMIR) Monastir, Tunisia ³,⁵IEEE Senior Member, LAPLACE, Université de Toulouse, CNRS, INPT, UPS, Toulouse, France

Abstract: Reducing energy consumption in all areas is an ecological and economic necessity. The energy losses are manifested in most cases by a release of heat which reduces the energy efficiency of the system. The recovery of these thermal losses, if they are in sufficient quantity, can be a solution to reduce the overall energy consumption of the system and increase its efficiency. The goal of this work is to explore a way to enhance the thermal flux dissipated by High Power LEDs to produce light through thermoelectric conversion by Peltier modules. This preliminary study appears to present a fairly promising method of producing light through the production of thermoelectric energy. The study was implemented by performing 3D thermal simulations using COMSOL™ simulation software.
Development of Smart Outlet for Active Power Usage
Lei Xiong¹, Goro Fujita², Takashi Minemura³
¹,² Power System Lab, Shibaura Institute of Technology Tokyo, JAPAN ³President and Representative Director, Minemura Electrical Engineering Corp Nagano, Japan

Abstract: In this research paper, we describe a smart outlet that we are developing and the process of designing and developing it. This smart outlet is assembled from three layers of circuit boards. The first layer installs a chip with a temperature and humidity sensor to collect real-time data, which allows us to remotely control the switch and view data such as power consumption, temperature and humidity on a computer or smartphone. The second layer is installed with HLW8012 sampling conversion device, which converts the collected voltage and current values into pulse signals and sends these pulse signals to the chip on the first layer. The third had is the power supply layer for the whole board, which provides 5V voltage for the whole board through AC-DC device. This layer will also contain fuses and circuit breakers for the safety of the whole circuit.
Design of Street Light Revitalization using Dialux Evo
Credo Malouna Saragih, Syamsir Abduh
Department of Electrical Engineering Trisakti University, Jakarta, Indonesia

Abstract: The development of road infrastructure and the increasing density on the highway, especially in big cities like the capital city of Jakarta, require adequate road equipment to provide security and comfort for public road riders, especially at night. One of the instruments supporting highway equipment as a support for road user safety is the Public Street Lighting (LPJU) lights. Currently the Kemayoran ExAirport area which is managed by the Kemayoran Complex Management Center still has a road width of 25 meters and uses high-powered street lighting instruments but the illumination level is not optimal with an average value of 11 lux for fast lanes with the SON-T lamp type 400 watts. The purpose of this study is to optimize the function of public street lighting in the Kemayoran Region by planning revitalization / rejuvenation of street lighting (PJU) using low power lighting with high lumens with Light Emitting Diode (LED) Lighting technology. The method used in this research is quantitative observations and calculations using international standards and SNI with lighting simulations using DIALux Evo software. The results of this study note that: Public street lighting system Jl. The most suitable Benyamien Sueb is to add a new PJU pole placement pattern in the middle median with 235 Watt lamp power in the fast lane and the existing pole with 140 Watt lamp power in the slow lane. This is evidenced by the results of the Dialux Evo simulation which shows the average value of lighting using LEDs reaching 48.7 lux (Fast Track) and 36.4 lux (Slow Track). This value has fulfilled the SNI 7391: 2008 standard for public street lighting with the classification of arterial-free roads.
PTS 1-4-7

155

Developing an Innovative Strategy to Achieve Energy Saving for Air Conditioning

Marwan Marwan¹, Tri Harianto², Dahlang Tahir³

¹Electrical Engineering Department Polytechnic State of Ujung Pandang Makassar, Indonesia ²Civil Engineering Department Hasanuddin University Makassar, Indonesia ³Physics Department Hasanuddin University Makassar, Indonesia

Abstract: The proposal of this study is to develop an innovative strategy to achieve energy saving for air conditioning (AC). In this research, an eco-wall and cooling model of building has been developed to consider the outside temperature (Tout) and thermal characteristics of a building. To evaluate the electrical energy cost (EC), discrete time optimization was applied to find the minimum electrical EC for the air conditioning (AC). As a result, the electrical EC of AC can be minimized to be IDR 25,200. In addition, this model has been tested on a sample building in Barru, South Sulawesi.
Review of Recent Research on Energy Saving Lamp in Indonesia
Umar Khayam, Arpan Zaeni
School of Electrical Engineering and Informatics Institut Teknologi Bandung Bandung, Indonesia

Abstract: Among many types of the loads, lighting has become one of major contributors to the electrical energy consumption. Study shows that 20% to 50% of electrical energy in the developing countries such as Indonesia is used by lighting. This condition causes there is a need to do more research about lighting. Some research had been carried out by Indonesian researchers by collaboration with laboratory from overseas. In order to be able to continue the research conducted by those researchers, a review of their research is needed so that it will be known what research that still can be developed and might can be carried out in Indonesia. Some research reviewed in this paper is about power quality and luminous properties of energy saving lamps (ESLs) under wide voltage variations, aging study of remote luminophore at ambient temperature, and detection of stroboscopic effect using controlled LED flickering.
Effects of Loading Factor on the Condition of Insulating Paper in Power Transformer
Nuriyanto Eko Saputro, Rahman Azis Prasojo, Geby Chintia, Suwarno
School of Electrical Engineering & Informatics Bandung Institute of Technology, Bandung, Indonesia

Abstract: The power transformer is one of the most important equipments that has a critical role in good electrical power delivery. Ageing of paper insulation inside the transformer is irreversible and hugely related to the operation of power transformer. This study involved inspection data from in-service and out-of-service 150 kV power transformers provided by the Indonesian electric company. The degree of polymerization (DP) of the cellulose paper insulation and furanic compound in the insulating oil can be used to estimate the transformer’s lifetime. In this study, the correlation between HI decreasing rate (HIdec_rate) and the loading factor of 115 transformers historical data was observed. The DP of the transformer paper was predicted (DPpred) using the ANFIS model using the dielectric characteristics and dissolved gases as input. The results show that the correlation between the DPpred decreasing rate (DPdec_rate) and the loading factor is more significant than that between the HIdec_rate and the loading factor.
Application and Comparative Analysis of Fuzzy Inference System for Transformer Fault Diagnosis with Dissolved Gases in Oil

Mehmet Murat Ispirli¹, Hasan Adali², Özcan Kalenderli³, Mehmet Zeki Celik⁴, Bülent Oral⁵

¹,³ Dept. of Electrical Engineering Istanbul Technical University
Istanbul, Turkey ²Field Engineering BEST Transformer Corp., Balikesir, Turkey ⁴Live Line Maint. Engineering of Head, Turkish Electricity Trans. Corp, Istanbul, Turkey ⁵Dept. of Electrical-Electronics Engineering Marmara University, Istanbul, Turkey

Abstract: Oils are used for cooling and insulation in transformers. The fault currents occurred on transformers can damage windings and insulation. As a result of this incoming fault current, gas emission occurs in materials such as oil and pressboard. The type of these gases released gives information about the fault of the transformer. In this study, it has been studied on the determination of the fault by analyzing the gases released as a result of the failure in 63 transformers using FIS. As a result of the analysis, the results obtained with FIS were compared with analyzed results with IEC 60599 and fault reports from the corporation, which these values obtained. When 63.5% true results were obtained compared to IEC 60599, 97.6% correct results were obtained compared to fault reports of the corporation because 22 of 63 transformer gas values were not actually suitable for applying the IEC Ratio method.
High Voltage Insulation Failure on HV Current Transformer: A Case Study in Diagnosis of HV CT Failure at Bekasi 150 kV Substation

I Gusti Ngurah Mahendrayana, Imam Makhfud, Arfan Idha Norgiyanto, Zainur Oktafian Prabandaru, Winarno
Transmission Maintenance Division PT PLN (Persero) West Java Transmission Unit Depok, Indonesia.

Abstract: Insulation in high-voltage equipment has a very important function as a part that separates the voltage from other parts, failure of insulation in high voltage equipment causes losses in operating of electric power transmission. High voltage Current Transformer (CT) with OIP type is a type of high voltage CT that is widely used to measure current in electrical power installations. Insulation on high voltage equipment is designed to be able to operate reliably, but the presence of stress such as voltage, heat, vibration, environmental conditions on the equipment causes a decrease in the insulation ability which can cause insulation failure. The conventional diagnostic methods to determine dielectric conditions in high voltage CT are by electrical testing including the tan delta test, capacitance and insulation resistance. A case study of the failure of the 150 kV CT occurred at the 150 kV Bekasi Substation in Indonesia, based on the results of the last electrical test that was carried out showed that the CT insulation condition was still in normal condition, for tan delta test with <1%, capacitance with <10% nameplate and insulation resistance > 11 GΩ but a major breakdown occurs on March 2021, according to this case study a comprehensive diagnostic method for dielectric conditions is needed to determine the insulation condition correctly and to avoid a breakdown due to insulation failure. The diagnostic method for high voltage CT that will be explained is by knowing the increase or grading of the tan delta test and combined with nonconventional method by dielectric frequency response test and partial discharge test.
Oil Insulation Analysis due to Electrical Arcing of Power Transformers Degradation
Syahputra, Muhammad Rully; Prasetyo, Mirza Farhan; Sufianto, Abdul Muiz; Septiani, Henny Ika
Maintenance Division, UIT JBT PT. PLN (Persero) Bandung, Indonesia

Abstract: One of the causes of the power transformer failure is the breakdown of insulation due to excessive heat. The excessive heat usually caused by various factors, one of that is a short circuit. The magnitude of the short circuit current that exceeds the standard of the transformer's ability to withstand the fault current can trigger a temperature increase in transformer oil which can appear the harmful gases known as fault gases and can provide axial-radial forces in the transformer. To find out early on the failure that occur in the transformer due to a short circuit, it is to conduct electrical testing on transformers and test oil insulation transformers with DGA method. In this contribution, an experience of the 150/20 kV 60 MVA power transformer case in Brebes Substation, the result of the DGA test analysis obtained significant increase in the TDCG trend from the DGA test results. Then, using the Key Gas method, there is an indication of electrical arching from the result of gas formation increase in C2H2 and H2 gases. Afterward, using the Duval Triangle method, which has been analyzed from the composition of CH4, C2H4, and C2H2 gases, obtain the results of the thermal fault condition. Furthermore, the isolation resistance test indicate the short circuit on the core-yoke part with the test result of 0 MΩ. Therefore, it can be concluded that the cause of the increase key gases in the DGA test results is the short circuit between the yoke shunt and the transformer core.
Cost and Benefit Analysis on Treatment Method of Aged Power Transformer Insulating Oil

Harry Gumilang
Maintenance Department PLN Unit Induk Transmisi Jawa Bagian Tengah, Bandung, Indonesia.

Abstract: Power transformers known as a vital asset for electricity utility especially in transmission sector. Beside the acquisition cost is huge, the maintenance cost is always need to be budgeted to maintain its performance. One of the common actions that usually conduct to maintain its performance is oil treatment. Oil treatment have many kinds depends on failure mode that happened to the oil. Oil filter or purification is a treatment method when the oil contaminated by moisture or foreign particles while oil reclamation or regeneration and oil changing are treatment method when the oil get oxidized due to heavy ageing. This paper will focus on comparing the methods in overcoming oxidized insulating oil. The methods that will be compared are oil changing, reclamation with dumping method and reclamation with re-activated method. Parameters that will be compared among those methods are cost risk and operational risk. The reason of comparing those risk is to find out which method is giving the lowest risk or the most optimal action to be chosen by asset manager to overcome oxidized transformer oil problem. In the end, based on cost and risk analysis it was concluded that oil reclamation with dumping method is the most optimal option to overcome oil oxidation problem.
Nursing Sick Transformers Using Online Dissolved Gas Monitors
Bhaba Das
Transformers Business Unit Hitachi ABB Power Grids Singapore.

Abstract: Condition based maintenance strategies in power transformers typically evaluate the risk of failure associated with the transformer by evaluating various parameters, one of which is dissolved gas analysis (DGA). Typically, offline DGA is performed once or twice a year. However, with sick transformers – transformers which show either an increase in fault gas levels or an increase in fault gas rates; manual sampling interval needs to be increased accordingly. This is when online DGA becomes effective. A diagnostic online DGA device allows to trend and diagnose faults within the transformer in near real time, which is the underlying strength of the online DGA device. In this paper, a case study is presented on an 85 MVA transformer, manufactured in the year 2000, where the concept of nursing sick transformer using online DGA monitor is presented. Using the concept of nursing, the transformer was kept in operation for a stipulated period which enabled delayed shutdown, continued operation of the sick transformer and subsequent replacement with a new transformer.
Solar PV-Wind Turbine Integration in Hydrogen Production to Generate Electricity through Fuel Cell
Syahril A. Ginanjar, Burhanuddin Halimi, Arwindra Rizqiawan
School of Electrical Eng. & Informatics Bandung Institute of Technology Bandung, Indonesia

Abstract: This research examines the integration of solar pv & wind turbines for hydrogen production and generate electricity directly or reconvert hydrogen to electricity through fuel cells. Electricity generated from sunlight and wind is promising for hydrogen production using water electrolyzer. The growth of energy system with the use of fuel cell technology requires basic understanding of fuel cell system as well as related power electronics. This research provides an overall system model including solar pv, wind turbine, electrolyzer, storage system, fuel cell systems, and grid integration model using MATLAB Simulink. Particular attention is paid to design energy mix from renewable energy. The power electronics system makes the electrical output synchronized with the existing power grid and load. In selecting DC-DC and DC-AC power converters, studies to the unique specifications have been carried out for system design purposes. The fuel cell output to the DC link can be transferred to loads with the converter and then to the grid using the three-phase ac grid-inverter. The system from the research can be developed with a combination of solar pv & wind turbine power plant, hydrogen production plant, hydrogen storage system, fuel cell power generator, hydrogen-based fueling station, electric vehicle charging station, and grid integration. Thus, this system has several advantages. Besides producing electrical energy, it can also be used as a backup power with hydrogen storage-fuel cells system. The hydrogen produced can also be used for various needs such as in petrochemical plants, oil refineries, and other industries.
Integration of Large-Scale Photo-Voltaic Based Generation into Power Systems
Muhammad A. Tayyab
Dept of Elec. & Computer Engineering, Auburn University, Auburn, Alabama, USA

Abstract: Interconnection of solar Photo-Voltaic (PV) as a viable electric power supply has been substantially increasing at both distribution and transmission levels. State and Federal policies are leading factors for renewable energy growth in the United States. A significant decrease in the price for PV systems in recent years and the incentives for renewable generation also led to a rapid increase in utility-scale PV installations. Several studies are required to determine the eligibility of a utility-scale PV plant integration into a power system. This paper aims to document the procedure and brief requirements of large-scale PV generation interconnection to an existing transmission system in the United States. The requirements for such interconnection are set by Federal Energy Regulatory Commission (FERC) and North American Electric Reliability Corporation (NERC). Interconnection request is followed by three study stages, the feasibility study, the system impact study, and the facilities study. For demonstration, a large-scale 200 megawatts (MW) PV plant is modeled along with a 200 MW battery storage system. This utility-scale PV plant is interconnected at 230 kilovolts (kV) transmission level in an existing 10,000 bus power system. Overloading issues and voltage criteria violations are analyzed using GE PSLF software under normal system P0 event and N-1 contingency P1 event. The mitigation techniques are presented for overloading and voltage violations. The effect of a large-scale PV generation on the net interchange between different areas in an interconnected power system is also reported.
Abstract: Solar power generation technology has been rapidly developed. Consider the technological developments and the solar energy potency in Indonesia, the government of Indonesia try to encourage the utilization of solar energy through the Government Regulation No.79 of 2014. One of the implementations of that regulation is by encouraging the use of rooftop solar power plant. The use of rooftop solar power plant is regulated on Minister of Energy and Mineral Resources Regulation No.13 of 2019 that one of rooftop solar power plant user is residential building. To make the residential customers more interested in using rooftop solar power plant, the costumers should be able to see the feasibility of installing rooftop solar power plant according to the user's location and the benefits that will be obtained by the costumers by installing it. According to that situation, the system designed in this study is an optimization for grid-tied rooftop solar power plant that combine the condition of solar energy potential at the user's location, especially residential customers in Indonesia, with energy requirements and regulations in Indonesia, so that costumers is able to get the recommended optimal capacity of their rooftop solar power plant and the savings that will be obtained by installing it.
Optimization of the Hybrid Power Plant Design (PV-Wind) for Residential Load
Giri Angga Setia, Ziega Zetu Zaen, Fauzia Haz, Handoko Rusiana Iskandar, Naftalin Winanti, M Reza Hidayat
Electrical Engineering Departement, Faculty of Engineering Universitas Jenderal Achmad Yani Cimahi, Indonesia

Abstract: The research aims to harness the potential of renewable energy in the residential sector of Cimahi City. Optimization design of hybrid generating systems require analysis to obtain the best scenario supply systems. One of the potential energies to be developed in Indonesia is photovoltaic and wind energy. The method used is design, modeling simulation, and implementation of the optimization of hybrid generation design based on photovoltaic and wind turbines. The design compares between on-grid and scheduling hybrid systems by using HOMER simulation which is used to calculate the component capacity, electricity production, NPC, COS, COE, and RF of the hybrid system. The results obtained that on-grid hybrid system is better and can be applied to residential loads compared to the hybrid scheduling system. Simulation result consists of the total energy production of 1023 kWh/year for PV system, 23.2 kWh/year for wind turbine, grid existing of 805 kWh/year, 0.500 kW for the inverter, and 0.540 kWh capacity of the battery. In terms of cost, these two systems have a difference of around Rp. 8,315,028.27. Because the operational costs of maintenance on the system affect the price of the Net Present Cost and Cost of Energy.
Steady State Load Flow Model of DFIG-Based Wind Turbine in Voltage Control Mode
Rudy Gianto
Department of Electrical Engineering Tanjungpura University
Pontianak, Indonesia

Abstract: The application of DFIG (Doubly Fed Induction Generator) in wind driven electric power generation has been increasing lately. In general, DFIG-based wind turbine has the capability to operate at two different control modes (i.e. power factor control mode and voltage control mode). However, the voltage control mode of operation has the advantage that the DFIG can be arranged to operate at a specified voltage magnitude and improve the system voltage profile. Load flow analysis is the most fundamental analysis in power system studies. Load flow analysis is usually carried out to assess the steady performances of a power system. The crucial and important step in conducting load flow analysis is modeling of the power system components. The present paper discusses a simple steady state load flow model of DFIG-based wind turbine in voltage control mode. The proposed model can be used for load flow studies of modern electric power system embedded with DFIG-based wind turbine.
Characterizing a 40-MW Modern Wind Power Plant by Field Data Measurements

Thoa Le Thanh, Dieu Vo Ngoc, Eduard Muljadi, Irving Paul Girsang
Dept. of Power Systems, HCM City University of Technology.
Vietnam National University HCM Ho Chi Minh City, Vietnam
Dept. of Electrical and Computer Engineering. Auburn University.
Alabama, United States.

Abstract: The weather and geographical location affect the character of a wind power plant. Understanding the unique behavior of a wind power plant is very important to optimize wind power plant operation from technical perspectives and financial aspects of the wind power plant. This paper characterizes an existing wind power plant to understand the behavior of a site-specific wind power plant. This paper presents the wind power plant based on location, the prevailing wind direction, the daily and seasonal average wind speeds. We monitored the field data from each turbine and the measurement at the point of interconnection (POI) where the wind power plant connects to the grid. We measure the average wind speed, power, and direction every minute. Simulation of the wind resource in the time domain throughout the year benefits the wind plant operator from monetizing the behavior of the wind plant at this Site. It also helps the utility host understand and plan the overall generating resources for longterm and short-term planning. In this way, we can forecast the annual energy production, the spinning reserve needed to balance the wind power plant, the transmission congestions that may occur, and the potential storage size/placement within the power grid in the future expansion of renewable deployment. The investigation described in this paper can guide the future design of wind turbine control, wind power plant control, and power system control.
Analysis of Bentonite AC and DC Performance Under Water Content and Chemical Content Variation for Grounding Applications
Zakka Izzatur Rahman Noor, Bambang Anggoro Soedjarno P, Pradita Octaviandiningrum Hadi
Electrical Power Engineering School of Electrical Engineering and Informatics, Bandung Institute of Technology, Bandung, Indonesia.

Abstract: Soil resistivity can be reduced by adding additives. Bentonite is a material that is quite good for reducing soil resistivity. This material is also recommended as a low resistivity material in the IEEE 80-2000 standard. Indonesia has many sources of bentonite, one of which is in the Karangnunggal area, Tasikmalaya. In this research, an experiment was conducted on the characteristics of bentonite against DC and AC currents with different levels of water content and chemical content. From the experiments, it was found that in DC testing, the higher the water content and chemical content, the lower the resistivity obtained. Meanwhile from the AC testing, the higher the water content and chemical content for each variation, the lower the average resistivity of the AC. The resistivity trend towards log f for each similar test is for low frequencies, below 200 kHz (log f = 6.3) the average resistivity value obtained does not change much. Furthermore, for frequencies up to 10 MHz (log f = 7), the resistivity value increases and decreases again until a frequency of 13 MHz (log f = 7.13).
83

Lightning and Grounding Parameters Effect to Flashover on 150kV Transmission Line
Novizon*, Silvia Wulandari, Nurfi Syahri
Electrical Engineering Department Universitas Andalas Padang, Indonesia.

Abstract: Effect of lightning parameters and grounding system impedance on transient overvoltage that occurs in 150 kV overhead transmission lines during lightning using ATP-EMTP modeling. The induced overvoltage that jumps across the insulator is calculated for further analysis. Various parameters that have a direct influence on the flashover phenomenon such as the effect of lightning strike amplitude, time of rise (front) and decay (tail) of lightning impulses, foot grounding system, and ground resistivity are discussed in more detail. Surge arresters are used in this study to overcome the overvoltage that can cause flashover. The performance of the transmission system after using a surge arrester is investigated at the time of a lightning strike. The results obtained indicate that the parameters of the advance time and the amplitude of the lightning current greatly affect the magnitude of the overvoltage. Other parameters have little effect on the overvoltage in the transmission line.
Study of Transmission Lightning Protection Installation in South Sumatera
A S Habibie, M Ridwan, K G H Mangunkusumo, Sriyono, A S Surya, D R Jintaka
Ristek TND PLN Research Institute, Jakarta Indonesia.

Abstract: South Sumatera is located in tropical area with high ground flash density; therefore the occurrence of transmission line due to lightning strike is very high. Installation of lightning protection such as Transmission Line Arrester (TLA) is an alternative solution to improve transmission performance toward lightning strike threat. The selection of installation location must be well determined and calculated in order to obtain the effective and efficient performance of the TLA itself. This paper describe the methods to determine the optimum TLA installation location by calculating vulnerability index using cluster and weighted method on transmission line (SUTT) with voltage level 70 kV and 150 kV in South Sumatera. The required data for the evaluation are lightning density, insulator fault, ground resistance and the height of the tower. TLA location determination on transmission tower is performed by using simulation and then validated by comparison with insulator fault data. The optimum location has been studied for the TLA installation on several transmission towers in South Sumatera. The most effective installation is obtained when the TLA is installed on the upper most phase conductor.
Installation of Multi Chamber Arrester to Improve Lightning Reliability Performance of Distribution Lines System in Oil and Gas Area
Syadila Refiasto, Bryan Denov, Suwarno, Reynaldo Zoro
School of Electrical Engineering and Informatics Institut Teknologi Bandung, Bandung, Indonesia.

Abstract: This paper discusses about lightning protection system for distribution line system, especially for 6.6 kV and 20 kV system. It contains lightning data analysis, evaluation of existing condition and the improvement of lightning protection system. The recorded data shows that the distribution line often experiences disturbances and damage such as broken transformers, broken arresters, line shutdowns etc. Lightning has the greatest potential as a cause of faults that occur in distribution line. By the research and calculation, some design of protection system had been proposed. In order to improve the performance of distribution line, the improvement of Ground Shield Wire, Metal Oxide Arrester and Grounding System must be done. Then, Multi Chamber Arrester is new technology which is also used to protect the distribution lines from the overvoltage of lightning. improvement of the reliability of the power system by the protection system is carried out using lightning strike data by the Lightning Imaging Sensor (LIS). Several installations carried out in the field are also presented in this paper.
Abstract: The 500 kV extra high voltage tower transmission line has the highest tower height among others towers transmission lines with the same voltage levels, therefore the possibility of shielding failure due to a direct lightning strike to the phase wire will be higher. This paper will study the design of the 500 kV Quadruple Circuit Compact Transmission Line which height is 105.35 m and the cross-arm length of Ground Steel Wire (GSW) from the center is 6.95 m. The maximum peak current of lightning that can strike the phase wire is 29.8 kA with the overvoltage on the upper phase of the insulator is 4010 kV. For this reason, a redesign will be proposed by increasing the cross-arm length of Ground Steel Wire (GSW) to improve the shielding angle, it will reduce the maximum peak current of lightning that can strike the phase wire (shielding failure) so that the overvoltage on the upper insulator is also reduced, this value will be adapted with the value of Lightning impulse withstand voltage of the insulator to prevent flashover.
Micro-Spatial Projection of Energy Demand Based on Dominant Factors Identification: An Exploratory Factor Analysis
Dwi Anggaini, Adri Senen, Hasna Satya Dini
Teknik Elektro Institut Teknologi PLN Jakarta, Indonesia

Abstract: The common energy projection method is macro-based model. As consequence, it is unable to show load centers in microgrids and failed to locate the distribution station. Thus, a macro model for forecasting cannot be applied in creating a master plan of electricity distribution. For this reason, micro-spatial energy projection needs to be implemented. Micro-spatial energy projection method falls into two categories; trending and multivariate simulation analysis. The more variables involved in energy projection, the more accurate the result. The projection is correlated to interaction among variables in the form of factors, as each service area has different dominant factors. Exploratory Factor Analysis was applied in this research to identify the dominant factors. This method is used to determine the dominant factors among observed variables. This research used 12 independent variables, 8 variables are grouped into 3 principal factors based on the result of component transformation matrix. The three factors are used in a mathematical model of projection of energy demand, so the result of projection can be more accurate.
Electricity Consumption Management System Design using Load Scheduling Method Based on Internet Of Things
Zaini, Adelina Utari
Faculty of Engineering Andalas University Padang, Indonesia.

Abstract: Electricity consumption in the household sector tends to increase during peak load time. It causes a significant difference between the power used during peak load time with outside peak load time. In fact, the bigger difference will become a problem for electricity companies because the generating capacity is not optimally utilized during outside peak load time. Consumers can reduce electricity consumption during the peak load time, or divert the use of it to outside peak load time. Apart from helping the government, this also helps ease the consumer economy. This paper aims to design an electricity consumption management system that can control electrical devices in small buildings in 3 modes: first, programming automatically according to user habits, second: remote control while away from home using android, third: manual or direct control while at home. This system is designed to be as effective as possible to limit the use of electric power based on the lifestyle of consumers. It is hoped that electricity consumption in small buildings such as households and commercial buildings can be saved and used effectively so as to reduce electricity costs. This system can even be integrated with the use of renewable energy sources during peak loads. The results showed that the consumer's electricity consumption at peak load was reduced by 15% by using this management system. Therefore, if everyone uses this system at home, the electrical load during peak loads can be reduced.
Comparative Power and Energy Consumptions between Scheduled and Fuzzy Controlling on an IoT-based Vertical Farming

Waluyo, Andre Widura, Febrian Hadiatna, Delvin Anugerah
Department of Electrical Engineering Institut Teknologi Nasional Bandung (ITENAS) Bandung, Indonesia.

Abstract: Recently, one trend of research is an investigation on vertical farming based on the internet of things (IoT). It involves some methods of controlling system, physical parameters including sensors and transducers, both hardware and software, and energy consumption. Nevertheless, this paper focuses on electric power and energy consumption. The electrical quantities were voltage and current, which were sensed and entered to Arduino Mega 2560 to be processed, and further to a Node MCU ESP8266, smartphone, and Blynk to monitor and log the data of power based on the internet of things (IoT). The loads were LED lamps and pH pumps through a relay. The controlling systems were scheduled and fuzzy bases, to be compared. The power was directly monitored and logged in every one minute by using the Blynk of a smartphone, whereas the energy was computed by using trapezoidal and Simpson’s composite rules. For one day, the fuzzy-based method could save 85.05 Wh (5.44%) and 84.32 Wh (5.42%) compared to the scheduled-based method, using the trapezoidal and Simpson’s composite rules respectively. The hourly-absolute-based energy differences between the scheduled and fuzzy bases were 116.66 Wh and 116.03 Wh using trapezoidal and Simpson’s composite rules respectively, for one day. While both computations yielded a deviation of 0.40% only. Thus, the fuzzy-base controlling method could considerably save consumed energy.
The influence of Wall on Reducing Electrical Energy Consumption for Residential Building

Marwan Marwan¹, Tri Harianto², Dahlang Tahir³
¹Electrical Engineering Department Polytechnic State of Ujung Pandang Makassar Indonesia ²Civil Engineering Department Hasanuddin University Makassar, Indonesia ³Physics Department Hasanuddin University Makassar, Indonesia.

Abstract: The effect of economic and population growth rapidly contributes to the energy usage of buildings increasing to high levels. To minimize the electrical energy consumption (EC), thermal insulation of wall has significant impact to minimizing the EC of building. The aim of this paper is to define the influence of wall on reducing EC of residential building with different wall characteristics. In this case, two different kinds of building characteristics were evaluated, namely: building-1 applied an innovative Cellular Lightweight Concrete (inCLC) brick and building-2 with wood applied to create the walls. Under numerical optimization, a mathematical model was developed to define the EC of air conditioning (AC). Based on the result of research indicated the EC of building-1 (IDR 25,365) was cheaper than building-2 (IDR 29,350). Consequently, the energy cost reduction (ECR) can be achieved to be IDR 3,985 (13.57%).
Economic and Environmental Assessment of the Implementation of Hybrid Auto-size Diesel Generators with Renewable Energy on Sebesi Island

Ali Muhtar\textsuperscript{1}, Purwono Prasetyawan\textsuperscript{2}, Sabhan Kanata\textsuperscript{3}, Syamsyarief Baqaruzi\textsuperscript{4} and Toto Winata\textsuperscript{5}

\textsuperscript{1,2,3,4}Electrical Engineering, Center of Research & Innovation for Conservation & Renewable Energy Institut Teknologi Sumatera Lampung, Indonesia \textsuperscript{5}Department of Physic Faculty of Math and Science Institut Teknologi Bandung Bandung, Indonesia.

Abstract: Sebesi Island is one of the small islands in Indonesia. The island has the opportunity to become a famous tourist destination in the future. The island has a beautiful beach panorama. In addition, the island has a lot of natural potentials. To meet its electrical energy needs, the island still uses diesel generators supplied by the state electricity company. The limitations of fossil energy, fuel prices, and transportation costs, as well as the impact of the resulting emissions, are the factors behind the research. Auto-size diesel generator (ADG) is still involved in this research as a form of the energy transition. This study examines the economic and environmental feasibility. The software used is HOMER. The scenarios being modeled are 1. photovoltaic (PV)-biogas generator (GBi), battery (BAT), 2. ADG-PV-GBi-BAT, 3. PV-wind turbine (WT), GBi-BAT, 4. ADG-PV-WT-GBi-BAT, and 5. ADG. There are six parameters used in the economic and environmental assessment, namely net present cost (NPC), cost of energy (COE), operating cost (OC), the renewable fraction (RF), reduction of CO2 emissions, and reduction of fuel oil. All scenarios will be compared with scenario 5 (base case). The simulation results show that the first scenario has the most advantages over the other scenarios. This scenario can be the best recommendation for the implementation of a hybrid energy system (HES) on Sebesi Island, South Lampung, Indonesia.
Strategy Plan on Electric Vehicle Charging Scheme for Peak Demand Reduction in Residential Area Transformer

Komaruddin\textsuperscript{1,2}, Suwano\textsuperscript{1}, Nanang Hariyanto\textsuperscript{1}, Kevin M. Banjar-Nahor\textsuperscript{1}

\textsuperscript{1}School of Electrical and Informatics, Institut Teknologi Bandung, Indonesia \textsuperscript{2}PT PLN (Persero), Jakarta, Indonesia.

Abstract: By the Electric Vehicle penetration, there will be additional new loads on the customer service transformer side. This paper will discuss the impact of Electric Vehicle penetration on the peak load on the 100 KVA Residential Area Transformer and also offers three strategies for charging the Electric Vehicle battery to reduce the peak load on these transformers. In this study, the Residential Area Transformers will be penetrated by the Electric Vehicle loads in stages 5, 10, 15, 20, 25, 30 EVs. This article will observe the impact of the penetration on the peak load of the transformers. There is a quite high increase in the penetration of EVs of 15, 20, 25, and 30 EVs. With the penetration of 30 EVs, the peak load on the transformers will increase to 123.6 KVA. This means that the 30 EV penetration exceeds the 100 KVA Transformer Residential capacity limit. Of the three EV charging strategies tested, with sequences per group of 4, 3, and 2 EV, it has been found that the best charging strategy to reduce the peak load of the transformer by shifting the peak load to the valley is charging strategy 2 with sequencing per group of 2 EV. By implementing the charging strategy 2 with sequencing per 2 EV groups, the peak EV load on uncontrolled charging is reduced from 123.6 KVA to 66.03 KVA, and there is a decrease in peak load by 46.59 percent.
Minimizing Electrical Energy Costs for Residential Buildings Based on the Characteristic of Walls

Marwan Marwan¹, Tri Harianto², Dahlang Tahir³
¹Electrical Engineering Department Polytechnic State of Ujung Pandang Makassar, Indonesia ²Civil Engineering Department Hasanuddin University Makassar, Indonesia ³Physics Department Hasanuddin University Makassar, Indonesia.

Abstract: The aim of this research is to compute the electrical energy cost (ECost) for residential buildings. In this study, there are five kinds of characteristics of walls that have been developed to manufacture different buildings. Under numerical optimization, the electrical ECost of residential buildings was calculated considering to wall characteristics and outside temperature. The result of this research described that the electrical ECost of residential buildings-I, II, III, IV and V were: IDR 29,800; IDR 28,700; IDR 27,300; IDR 26,400 and IDR 25,200. In addition, the proposed study only calculated the electrical ECost of the air conditioning during hot days in Barru, South Sulawesi.
Financial and Technical Forecast Analysis of a Hybrid Biomass-Diesel Power Plant - Case Study in Tinggi Island, South Bangka

Ginas Alvianingsih¹, Vendy Antono², Iwa Garniwa³
¹Faculty of Electricity and Renewable Energy Institut Teknologi PLN Jakarta, Indonesia ²Faculty of Energy Technology and Business Institut Teknologi PLN Jakarta, Indonesia ³Department of Electrical Engineering Universitas Indonesia Depok, Indonesia

Abstract: Tinggi Island is located off the South Bangka Regency coast, with an electricity peak load of 7.5 kW supplied by the 40 kW diesel power plant. One of the problems in the provision of electricity in Tinggi island is difficulty in delivering fuel process. This problem causes expensive fuel prices and a limited amount of fuel. This research aims to analyze the technical and financial of a hybrid 16 kW biomass power plant with the existing diesel power plant. The method used in this research is to estimate the energy generated by the diesel and biomass power plant, the fuel required, and the payback period by calculation. From the study, the diesel power plant will produce 1,999.53 kWh of electricity per month with the need for diesel oil of 1,939 liters. Meanwhile, the biomass power plant will produce 2,077.53 kWh of electricity per month with a biomass requirement of 2,078 kg. Based on financial analysis, waste pellets, risk husk, and wood charcoal as biomass power plant's fuel have good feasibility with a payback period between 1.9-2.6 years. In contrast to the three types of biomass, palm shells are not economically feasible to use as fuel because they are more expensive than diesel fuel.
The Study of Electric Field and Partial Discharges on XLPE Insulation under DC High Voltage using COMSOL Multiphysics
Apoorva Sahu, Rakesh Sahoo, and Subrata Karmakar
Department of Electrical Engineering
National Institute of Technology Rourkela, India.

Abstract: Partial discharges measurement and analysis is one of the prime factors when it comes to the condition assessment of power cables. The presences of microcavities in the manufacturing process are the major cause of field enhancement when subjected to high voltage stress. These are the precursor of PD activity, if it continued for longer duration; there may be a chance of insulation breakdown. This work mainly emphasizes the distribution of electric potential, electric field, and PD activities in the presence of artificially created cavity defects of an XLPE insulation sample using the finite element method by COMSOL Multiphysics software. The simulation has been carried out in both normal and defective samples by varying elliptical and spherical cavity geometry, cavity location, and supply voltage. The characteristics of the initial behavior of applied DC voltage are also analyzed before it reached a steady-state value. PD inception voltage and 2-dimensional time resolve pattern are also analyzed by integrating COMSOL Multiphysics with MATLAB environment.
FTIR and SEM Analysis of Breakdown XLPE Cable Insulation
Hakim Habibi, Aji Suryo Alam, Oksa Prasetyawan, Guntur Supriyadi
Transmission and Distribution Dept, PLN Puslitbang, Jakarta, Indonesia.

Abstract: The degradation and breakdown of high-voltage XLPE cable insulation are usually followed by morphological and chemical changes. This paper presents the outcome of Scanning Electron Microscopy (SEM) and Fourier Transform Infrared Spectroscopy (FTIR) tests on broken-down cables. Tests are conducted on several sample points of the broken-down cable at one of PLN’s substations. As a comparison, the tests are also applied to the unbroken-down part of the same cable roll the unbroken-down cable of another brand. Striking differences are obtained from the results of the tests. The experimental results show a higher absorption peak at the double bond area on the cable that breakdown indicates the high presence of the carbonyl group due to polymer oxidation. And the cable that is one roll with the cable that breakdown has a high oxidation index even though it is relatively new. This proves the lower quality of the cable that breakdown compared to the other brand.
Study The Properties Of Mixed Kenaf And Empty Fruit Bunch (EFB) Oil Palm Fibre Insulation Paper
Ja’afar Bin Adnan¹, Mohd Taufiq Bin Ishak², Nurul ‘Izzati Binti Hashim³, Fakroul Redzuan Bin Hashim⁴, Rushdan Bin Ibrahim⁵, Rahisham Abd Rahman⁶
¹,²,⁴Dept. of Electrical and Electronics Engineering, Faculty of Engineering, National Defence University of Malaysia Kuala Lumpur, Malaysia; ³Dept. of Electrical and Electronics Engineering, Faculty of Engineering, University Malaysia Sarawak Sarawak, Malaysia; ⁵Pulp and Paper Laboratory, Forest Research Institute Malaysia, Selangor Malaysia; ⁶Faculty of Electrical and Electronics Engineering, Univeriti Tun Hussein Onn Malaysia, Johor Malaysia

Abstract: Cellulosic fibre composites from agriculture waste product bast fibre such Empty Fruit Bunch (EFB) oil palm has lower cost than normal softwood fibre and they are great alternative to be considered in insulation papermaking. For this purpose, EFB fibre, kenaf fibre and their blend were used to fabricate electrical presspaper samples through a laboratory papermaking process. The study of physical, mechanical and electrical properties such as cellulosic structure, tensile strength, AC voltage breakdown and lightning impulse breakdown strength were conducted according to the standard testing method of insulation IEC60243-1:2013. From this research, the physical structure, mechanical and electrical behaviour of mixed EFB and kenaf fibre insulation paper are comparable to Kraft paper and qualified the basic criterion to be an electrical insulation paper as required by IEC60641-2 standard. The purposes of this insulation paper produced is to be use in electrical transformers, therefore the same test should be repeated to the insulation paper that have undergone aging process at normal and accelerated operating temperatures.
Comparative Study of Accelerated Thermal Aging of Papers in Mineral Oil, Natural Ester, and Gas-to-Liquid
Ilhamid Daris, Mawla Ahmad, Hardiansyah Rahmat Nurhakim, Suwarno
School of Electrical and Informatics Engineering Bandung Institute of Technology, Bandung, Indonesia

Abstract: Mineral oil has long been used as an insulating liquid in transformers. Natural ester-based oil is an alternative due to its non-toxic and biodegradable characteristics. Then this study compared the rate of degradation of accelerated thermal aging paper impregnated in natural ester oil (NE) with mineral oil (MO) and Gas-to-Liquid (GTL). Sealed glass bottles containing thermally upgraded kraft paper (TUK), kraft paper (KP), pressboard (PB), and oil in an atmospheric environment were aged in an oven at 150 °C within 1344 hours. Observations were made at intervals of 336 hours during the aging. The rate of degradation of the paper was observed through the Degree of Polymerization (DP) test of kraft paper, while the chemical structure of the paper was observed through the Fourier Transform Infrared (FTIR) test of the paper. In addition, acid and moisture tests were also carried out to observe the oil-paper interaction during aging. The depolymerization rate of paper in natural ester oil is smaller compared to other oils. This indicates that NE has better thermal stability and can extend life of the transformer paper. The paper aging rate in MO is similar to GTL Oil because they both are hydrocarbons-based.
Power Quality Study of Microgrid with Single Large Solar PV and Distributed Small Solar PVs Plant: Case Study Karampuang Island

Ridho Arisyadi, Tri Desmana Rachmilda, Deny Hamdani
School of Electrical Engineering and Informatics Institut Teknologi Bandung Bandung, Indonesia.

Abstract: Indonesia already implements microgrids in small islands and very isolated areas. Usually, those microgrids use renewable energy power plants such as solar PV. This is also in line with the Indonesia Government’s step to deploy more renewable energy in its power generation system to reduce Greenhouse Gasses Emissions. One of the several microgrids with solar PV plants already been implemented in Indonesia is Karampuang Island Microgrid. Currently, their electricity supply by four Solar PV microgrids which are separated and not connected yet. In this study, two schemes of Karampuang microgrid expansion are examined. The first scheme uses a single Solar PV power plant and a battery energy storage system (BESS). The size of the Solar PV plant and BESS is the total capacity of the current condition. The second scheme is the microgrid using four distributed solar PV power plants in their current location and capacity. The Solar PV connects among them to supply the island's load in one grid. The power quality of both microgrid schemes is examined. The power quality phenomena, i.e., total harmonic distortion and temporary overvoltage of both schemes, are examined by Matlab/Simulink software simulation. The THD and temporary overvoltage in Distributed Solar PV microgrid are better than the single solar PV microgrid.
Indonesia’s New Capital Challenge: Developing Sustainable Business Model for Off-grid Photovoltaic Company

Arien Hanadya¹, Bagas Maulana Sutardi²
¹Master Student, Young Professional MBA SBM-ITB (Institut Teknologi Bandung) Bandung, Indonesia, 40132 ²Operations System, UP3B West Kalimantan PLN (Perusahaan Listrik Negara) Pontianak, Indonesia, 78115.

Abstract: Indonesia is now facing challenges to implement for more efficiency, higher reliability, and better availability in the electric supply industries, as witnessed by various striking plans and promotional activities in the Alternative Energy Development Plan, which was being stated in the 10-year RUPTL. Digital power plant is an important breakthrough initiative for PLN itself. Moreover, variations of the planning electricity supply industry (ESI) in the new capital of Indonesia differ from those in the Jakarta (ex-capital 2025) in many aspects. The increasing number of renewable generation (i.e., wind, solar, hydro) into PLN power grid brings new visions and opportunities for enhancing utility of PLN future power industry. Nevertheless, the growing penetration of variable renewable energy especially photovoltaic insertion in the electricity system raises concerns and pose challenges in long term electricity stability and thereby the security of supply chains in PLN energy sector. High variability and volatility as well as scale and complexity of Renewable Energy Sources (RES) are challenging for supplying the electricity and balancing its demand. The direction issues of the development of power transmission and distribution system in PLN power infrastructure are needed to be highlighted.

Abstract—Indonesia is now facing challenges to implement for more efficiency, higher reliability, and better availability in the electric supply industries, as witnessed by various striking plans and promotional activities in the Alternative Energy Development Plan, which was being stated in the 10-year RUPTL. Digital power plant is an important breakthrough initiative for PLN itself. Moreover, variations of the planning electricity supply industry (ESI) in the new capital of Indonesia differ from those in the Jakarta (ex-capital 2025) in many aspects. The increasing number of renewable generation
(i.e., wind, solar, hydro) into PLN power grid brings new visions and opportunities for enhancing utility of PLN future power industry. Nevertheless, the growing penetration of variable renewable energy especially photovoltaic insertion in the electricity system raises concerns and pose challenges in long term electricity stability and thereby the security of supply chains in PLN energy sector. High variability and volatility as well as scale and complexity of Renewable Energy Sources (RES) are challenging for supplying the electricity and balancing its demand. The direction issues of the development of power transmission and distribution system in PLN power infrastructure are needed to be highlighted. Accordingly, the long-term strategic plan of Indonesia’s new capital 4.0 policy reacts to promote green power for sustainable development. The more requirements for clean energy implemented, the better alternative energy should be executed, and thus Indonesia can reach to overall improvement of the energy efficiency. At the present, the share of renewable energy consumption from the current situation is 12,552 GWH (13.65%) to ultimate goal of thirty percent (23%) equal to 94,956 GWh in total energy consumption by 2025. This is set up as well as the commitment to the development of a low-carbon society is established. The principal objectives of this paper are three-fold. In summary, this paper is to explore the developing sustainable business model for off-grid photovoltaic company into power systems using insights from Indonesia’s new capital. Key success factors and obstacles are also pointed out. Then, the paper is to illustrate the nine (9) building blocks of the Business Model Canvas (BMC) to implement the strategies for integration of off-grid photovoltaic company in PLN energy sector. Finally, the initial ideas for demonstration projects in the various area of Indonesia’s new capital are spotlighted. Following this, successful applications are further discussed and presented.
Military Microgrid in Indonesia
Dianing Novita Nurmal Putri, Eddie Widiono Suwondo, Syamsir Abduh, Tyas Kartika Sari, Chairul G Irianto, Maula Sukma Widjaya
Electrical Engineering Department Universitas Trisakti Jakarta, Indonesia.

Abstract: One of the tasks of military forces is to defend the country. Furthermore, Indonesia has more than 300,000 people serve as a military force like army, navy, or air force and has to be ready anytime to serve the country. On the other hand, the usage of electricity in military activity is very important. Thus, having reliable and secure sources is mandatory. In addition, one of the advantages of a microgrid are reliability, security, and also clean energy, so having a military microgrid in Indonesia also means that it will help to achieve the Indonesian government target to increase 23% of renewable energy share by 2030. This paper discusses the overview of military microgrids and also a study case with techno-economic calculation for one of the military bases in Indonesia. By Importing the solar data, load data, diesel and also Photovoltaic (PV) data, HOMER Pro search the best combination of feasible solution with constrain given. The result proposes four different architecture combination of PV, Diesel, Battery on grid and off grid. The cheapest solution with backup is system 4 where the combination is consisting of PV and battery with on grid system with LCOE USD 0.024 and serve the 1124,86GWh/year load.
Design and Analysis of Hybrid Off-Grid PV-Battery-Genset System for Communal and Administrative Load Under Cycle Charging Control Strategy at Patippi Village, Papua
Abdu Yakan Rosyadi, Agus Purwadi, Muhammad Ridhwan
School of Electrical Engineering and Informatics, Institut Teknologi Bandung Bandung, Indonesia.

Abstract: Indonesia's renewable energy potential reaches 443 GW. The potential for solar energy has the largest portion up to 207 GW. Indonesia has average irradiation of 4.8 kWh/m2/year. Even though it has great renewable energy potential, its utilization is still minimal. Indonesia still has areas that are not yet electrified. Patippi Village is one of the isolated villages in Asmat Regency, Papua. This village has a potential emission of 4.6 kWh / m2 / year with a communal load requirement of 31.08 kWh / day and an administrative load of 11.658 kWh / day. Hybrid PV-Battery-Genset systems integrate renewable energy sources to generate electricity for distribution to the regions to increase system reliability. The design and analysis were carried out using MATLAB / Simulink and HOMER Pro software with a Cycle Charging control strategy. The results of the analysis are used to implement a reliable off-grid PV-Battery-Genset hybrid system in clear and cloudy skies, with an economical Levelized Cost of Energy (LCOE) and Net Present Cost (NPC).
Analysis of Hybrid Diesel-Biogas for Palm Oil Mill Electrification and Environmental Sustainability

Syafii, Pinto Anugrah, Dewi Kusuma Wardani
Electrical Engineering Department, Engineering Faculty, Universitas Andalas Padang, Indonesia.

Abstract: This paper presents an economic analysis of the hybrid diesel-biogas plant for the electrification of palm oil mills and the reduction of greenhouse gas emissions. A palm oil factory load in remote Sumatra area is used as a case study. The optimization configuration, economic and environmental aspects were analyzed using HOMER software. The optimization result obtained 78.7% of total electricity is supplied by hybrid diesel-biogas generators with net present cost (NPC) of IDR 130,693 million and cost of energy (CoE) of IDR 2,142/kWh. The operating cost of the system is relatively low due to a reduction of diesel fuel consumption. The hybrid system also reduced greenhouse gases emission compared to non-renewable power system. Environmental sustainability is obtained through efforts to increase biogas power generation and reduce the use of non-renewable power system.
Optimal Design of Rooftop PV Systems for Electrical Engineering Department Laboratory
Handoko Rusiana Iskandar¹, Nana Heryana², Naftalin Winanti³, Giri Angga Setia⁴, Rijal Ridwanulloh⁵, Muhammad Rizky Alfarizi⁶
¹,³,⁴,⁵,⁶Electrical Engineering Department, Faculty of Engineering, Universitas Jenderal Achmad Yani Cimahi, Indonesia, ²School of Electrical Engineering and Informatics, Institut Technology Bandung Bandung, Indonesia

Abstract: Photovoltaic ensures that it can be used both communally and independently and that it will become a renewable energy solution in the future, as well as a support for other energy sources other than fossil energy. This paper discusses an optimization of a rooftop PV system in an Electrical Engineering Laboratory (EEL) connected to a utility grid. This design was created to improve on the previous year’s design while meeting the load capacity requirements of the existing laboratory. The number of PV panel units are all optimized to meet and supply existing electricity. The development findings reveal that the rooftop PV mounting system provides 243 PV panels with a total power output of 60.750 kWp for the roof area with the installation of 60 kW inverter units connected to the grid. The optimum tilt angle of the four cardinal points is adjusted to reduce shade losses. The quantity of batteries is proportional to the autonomous time, ensuring that the rise in battery capacity is not overlooked.
Adaptive Protection Coordination Scheme for Distribution System Under Penetration of Distributed Generation

Ra Crystal S. P. Tambun, Kevin M. Banjar-Nahor, Nanang Hariyanto, Fathin Saifur Rahman, Rizky Rahmani
School of Electrical Engineering and Informatics Institut Teknologi Bandung Bandung, Indonesia.

Abstract: Proper design of protection scheme is one of the problems that arise when distributed generation penetration increases. This is due to the changes in system condition from previously radial to multi-source causing modifications of the magnitude and flow of the fault current. Therefore, the conventional protection schemes that do not consider the direction of the current flow become insufficient to protect the system. Therefore, adaptive protection scheme that can adjust its settings dynamically depending on the condition of the system is needed to keep the system safe. The proposed adaptive protection scheme is tested on the IEEE 3-bus test system on two conditions, the absence and presence of distributed generation. The algorithm is implemented on MATLAB and then verified on Power Factory 2020 to test its effectivity to clear the 3 phases, 2 phases, phase-ground and 2 phases – ground fault current. This algorithm also uses current contribution to prevent the occurrence of protection blinding and sympathetic tripping on this protection scheme. The proposed protection scheme is able to maintain the selectivity of relay operations despite changes in system topology, especially due to distributed generation.
Near Real-Time Power System Simulation in SCADA
Muhammad Mushthofa Musyasy, Kevin Marojahan Banjar Nahor, Nanang Hariyanto
Electrical Power Engineering School of Electrical Engineering and Informatics Bandung Institute of Technology, Bandung, Indonesia.

Abstract: This paper discusses an integration between SCADA and DlgsILENT PowerFactory. This integration allows near real time data transfer for further analysis purposes. The communication protocol used is OPC. The main software used are DlgsILENT PowerFactory and MatrikonOPC Explorer, as the OPC clients, and MatrikonOPC Server for Simulation, as an OPC server. State estimation, which is the key calculation of power system analysis, will be conducted and validated. The data used to simulate the measurement values are the results of the load flow analysis, with some level of errors. The results of state estimation show that the average differences between the state estimation results and the original load flow calculation values, the average deviations and the IISEA are less than 10% for variations of error less than 10% and 5% no meters. A simulation of redundant meters shows that the average difference is 10,16% and the average deviation is 4,11%, while the IISEA is 3,71%. In addition, contingency analysis can provide an index for a component outage and load flow analysis can be used to check the highest PI value, simulate transformer tap changes. The SE process takes 31 seconds, contingency analysis takes 12 seconds, and load flow analysis takes 1 second.
Modelling Transposed-150kV-HVTLs West Kalimantan Subsystem and 275kV SEB-PLN Interconnection Voltage Unbalance Mitigation

Bagas M. Sutardi

Abstract: The 275kV regional interconnection HVTL Mambong (Sarawak) to Bengkayang (West Kalimantan) imposes challenges to the GSO (Grid System Operators) to maintain the voltage levels and voltage unbalance within limits. We suggest how to design the strategies for stable operations under unbalance system situations for the power system interconnection. According to the existing concept, the transposition of transmission line phases is intended to reduce the current and voltage unbalance in the normal electrical system operating mode and to limit the obstructive influence of transmission lines on the transmission channel of low frequency. The length of the transposition process for lines with horizontal phase allocation should not exceed 24 km, and should not exceed 48 km at triangle allocation. The discrepancy in its parameter at one transposition interval is not completely balanced over the entire process, since the line is distributed at different conditions at one of the intervals. For a period in total the resulting parameters of line phases are different. Thus, even at the exact symmetry current and voltage systems at one end of the full transposition cycle, these systems at the other end become imbalances. This paper provides an analysis by applying the EMT Evaluation (Electromagnetic Transients Analysis) of the transposed 150 kV (Tayan-Sandai) transmission line of 162 km length. In this way, the findings obtained attest to the continuity of the inquiries and can also be used to address the problems of the specification of acceptable unbalance rates in longer lines.
Study on The Use of Virtual Synchronous Generators to Improve Large Scale System’s Stability

Diya Li¹, Sandro Sitompul², Goro Fujita³
¹Electrical Engineering and Computer Science Shibaura Institute of Technology Tokyo, Japan ²Regional Environment System Shibaura Institute of Technology, Tokyo Japan ³Department of Electrical Engineering Shibaura Institute of Technology Tokyo, Japan

Abstract: Nowadays, under the influence of environmental problems and resource exhaustion problems, the method of applying distributed generation in power systems is gradually being widely used. However, in large-scale interconnected power systems, low-frequency vibrations caused by mechanical vibrations of power devices and disturbances in a certain system will affect other modules connected in the same system, thereby affecting the stability of the entire power system. In order to eliminate this kind of inter-regional influence, maintain the stability of the power system. This paper attempts to design a control method based on VSG. VSG is often used in power systems where there are distributed power sources such as solar power generation for renewable energy generation. Because this kind of distributed power source does not have the same inertia as the synchronous generator, so when the system is disturbed, the overall stability of the system will deteriorate, and the VSG has the ability to track the maximum power point, which can make this type of distributed generation have the same inertia as the synchronous generator. When the stability of the small system changes, the overall system can still remain stable. This article will focus on the effect of the VSG on the transient stability of the large-scale system. Through the establishment of a simulation model, and verify that the whole system can keep stable due to the function of VSG when fault or disturbances occur in the system.
Design of Load Balancing Method on Secondary Distribution Network Using Artificial Intelligence Based on Fuzzy Logic
Rivzky Prananda, Hasna Satya Dini, Tri Wahyu Oktaviana Putra
Faculty of Electricity and Renewable Energy Institut Teknologi PLN
Jakarta, Indonesia

Abstract: In order to reduce load imbalance on distribution power transformer, Indonesia Electrical Power Utility (PLN) is using Load Balancing strategy. According to the Circular Letters of the Directors of PT. PLN (Persero) No. 0017E/DIR/2014 regarding Distribution Transformer Maintenance Methods Based on Asset Management Rules on distribution transformers stipulates a good load imbalance, 10%. Based on the load measurements carried out on the distribution transformer NBR 022 with a capacity of 200 kVA supplied by the Matoa feeder, the load imbalance value was 11.25% and 12.74% in 1st semester of 2021 and 2019 respectively. The peak load measurement in 2019, 2020, and 1st semester of 2021 were employed as the input for load balancing using Fuzzy Logic Algorithm. Fuzzy logic has the advantage in faster data processing than the conventional balanced day-to-day method that commonly used to perform load balancing. According to simulation, Fuzzy logic can reduce load imbalance from 11.25% to 4.18% in the 1st semester of 2021 and 12.74% to 8.29% in the 1st semester of 2019. These results indicate that Load Balancing using Fuzzy Logic could decrease the load imbalance to the value below 10%. In addition, the percentage of loading in each phase is more evenly distributed after balancing the load using fuzzy logic. So, this proves that the fuzzy logic program can work well for load balancing.
System Out of Step Evaluation on Java-Bali EHV System during Double Line Transmission Disturbance

Hariadi Aji, Yonny Wicaksono, Putranusa Perkasa, Zilfa Hasanita Natalia, Aan Nur Arifin, M Nugratama Sudarsanto, Jarot Setyawan, Yenni Tarid
Java Bali Load Dispatch Center PT.PLN (Persero) Depok, Indonesia.

Abstract: Transient Angle Stability study is one of the most important system stability studies that define transfer capacity in the Java-Bali transmission system. The worst condition happens if the transfer exceeds the total transfer total capacity and an unwanted hazardous contingency occurs in the transmission lines. If that happens, the rotor angle of the generator or the voltage angle in some buses in the system may go to the loss of synchronism state. Conventionally, a distance relay with the out-of-step function can prevent the system from going into catastrophe by splitting the system in the electrical center. This paper shows a brief illustration of Java-Bali's EHV Transmission lines addition and reconfiguration in the near period. A study of the EHV system characteristics when a double line outage (DLO) contingency occurs is done with the time-domain simulation of the Java-Bali system model using DlgSILENT Power Factory. A review about impedance locus during power system swing or transient rotor angle disturbance is conducted. The voltage stability phenomenon during severe rotor angle stability phenomenon is studied. Eventually, the electrical center locations during several DLO contingency cases can be identified. These locations can be marked as important locations to raise the attention to the out-of-step relay functionality.
Virtual Synchronous Generator Control Considering Output Upper Limitation
Yuki Hayashi¹, Sandro Sitompul², Goro Fujita³
¹,² Graduate School of Engineering and Science Shibaura Institute of Technology, Tokyo, Japan; ³College of Engineering Shibaura Institute of Technology Tokyo Japan

Abstract: In recent years, there has been a growing interest in renewable energy resources, which are becoming increasingly popular. With the increase of power generation using distributed energy resources (DER), there is a concern about the lack of inertia in the power system. Virtual synchronous generator (VSG) control is known to improve the stability of the grid by providing virtual inertia to the inverters that link DER to the grid. However, in the event of an accident, the inverter is required to instantaneously generate more power than its rated capacity. When power exceeding the rated power is generated, the inverter may be damaged, and operation cannot be continued. In this paper, the stability of the inverter was verified by setting a power limit above the rated power. As a result, it was found that although it was less than ideal VSG control, it was quicker to return to normal operation than conventional inverters.
Optimized Hybrid Power System Configuration for The First Phase of Dedieselization Programs
Devni Syafrianto¹, Kevin Marojahan Banjar-Nahor², Herry Nugaraha³, Dzikri Firmansyah Hakam⁴, Pradita Octaviandiningrum Hadi⁵, Nanang Hariyanto⁶
¹.³.⁴Centre of Excellence for Generation & Renewable Energy PT PLN (Persero)
Jakarta, Indonesia ².⁵School of Electrical Engineering & Informatics Institut Teknologi Bandung Bandung, Indonesia

Abstract: To boost renewable energy utility for achieving the target of 23% renewable energy mix by 2025, PT PLN (Persero) launches the diesel conversion to renewable energy program that well-known as Dedieselization program. For the first phase, PLN locks target to convert 225 MW of diesel power plant in 200 locations to the renewable energy power plant. To align renewable energy potential utilization with affordable cost and to qualify with data confidentiality, this paper will figure out optimized hybrid power system configuration for three sampling islands: Island A, Island B, and Island C. These three islands will deal with three considered aspects: low Levelized Cost of Electricity (LCOE), less capacity shortage, and less land utilization. Simulation using HOMER Pro for configuration without diesel utilization deliver results that capacity shortage still occurs. Meanwhile, Hybrid configuration that utilizes diesel plant deliver zero capacity shortage. Furthermore, scoring that refer to simulation result and optimized parameter conclude that Hybrid PV/BESS/Diesel is the most optimized configuration for Island A and Island B. Otherwise, Island C has Hybrid PV/Diesel as the most optimized configuration. Finally this paper conclude that any dependency to diesel utilization to succeed Dedieselization program that deals with low LCOE, zero capacity shortage, and less land utilization.
Assessment Procedure for Advanced Metering Infrastructure Implementation in Indonesia
Erny Anugrahany, Guntur Supriyadi, Dimas Aji Nugraha, Oksa Prasetyawan W, M. Muslih Mafruddin
Transmission and Distribution R&D PLN Puslitbang Jakarta, Indonesia.

Abstract: PLN has decided to start its Advanced Metering Infrastructure (AMI) project in its journey into smart grid implementation. Compared to the conventional metering system, AMI offers a better meter reading efficiency and many other important functions and features. However, so many products have been available in the market with various quality and topology. Choosing a proper and suitable product is essential since it can affect the company's performance in the long-run implementation. Some assessments need to be conducted to ensure product quality and interoperability. This paper proposes a set of assessment procedures for AMI deployment in PLN. The assessment procedure is developed by combining references from several countries and adjusting some items to meet PLN needs. This assessment procedure can lead to a PLN preferred AMI system.
Abstract: In recent years, utility companies have transformed from using automated meter reading (AMR) technology to Advanced Metering Infrastructure (AMI) in line with digital transformation program to develop energy measurement systems. The AMI energy measurements can be more accurate, real-time, efficient, and provide customer access. Operational reliability and security of measurement devices, communication facilities, data analytics, and other related AMI devices must be integrated, managed, and monitored using a monitoring system that continuously ensures all processes run well and detect any peculiar conditions. The AMI ecosystem is critical to consolidate all measurement points of energy transactions from the generation, transmission, and distribution sectors. AMI also manages all measurement points at substations, distribution substations, and all major customers to ensure accuracy and transparency of electrical energy distribution in the distribution sector. Therefore, a meter operation center is needed to operate and monitor the electric power measurement system working in a good performance. This paper discusses designing a meter operation center as part of the AMI program. The MOC development is carried out in stages using rapid application development, enriched with several improvements from the previous centralized AMR system. The implementation has shown a well-functioning MOC system with complete measurement parameters, large capacity end-devices connected, energy measurement forecasting, demand-side management, and the ability to monitor grid voltage, power interruptions, and power quality. The performance of this MOC will significantly help achieve the implementation and execution of AMI to provide an accurate, precise, and fast energy measurement system and guarantee utility revenue.
Development of Meter Data Management System Based-on Event-Driven Streaming Architecture for IoT-based AMI Implementation

Ignatius Rendroyoko¹, Antonius Darma Setiawan², Suhardi³
¹,³School of Electrical Engineering and Informatics Institute Technology of Bandung Bandung, Indonesia ²Department of Electrical Engineering Jakarta Global University Jakarta, Indonesia.

Abstract: Building an accurate, precise, fast, and extensive capacity metering system is mandatory for electricity utility companies. Therefore, several years ago, utilities have built automated meter reading (AMR) systems to run energy measurement business processes to help companies earn revenue. With the growing demand for utilities for detailed and real-time energy measurements at customers, utility companies need to migrate technology from AMR to Advance Metering Infrastructure (AMI). This effort will require the development of information technology and supporting equipment. One of them is the Meter Data Management System (MDMS). It is an essential part of the AMI system to handle the utility company’s business processes and the Service Level Agreement (SLA). This paper discusses developing an MDMS for an electricity company’s AMI energy measurement system using an IoT-based approach. It leads to a massive meter reading in a certain interval period and handling such conditions required implementing the event-based streaming architecture. The Head-End System (HES) uses the enhanced AMR-based one. The measurement results of the proposed MDMS-HES for AMI show the reading process can handle massive meter reading precisely and detect any abnormal measurement quantities. The reading interval only takes 37.5% of the SLA required by the utility company to read 100% of the meter population. This advanced capability can guarantee better measurement results and guarantee the certainty of the company’s revenue.
Guidance on Communication Media Selection for Advanced Metering Infrastructure in Indonesia
Transmission and Distribution Department PLN Research Institute
Jakarta, Indonesia.

Abstract: Indonesia is a country with diverse geographical conditions. The performance of the communication media is greatly influenced by the contours of the area and the shape of the surrounding buildings. There is no single choice solution for communication media to meet the needs of Advanced Metering Infrastructure (AMI) in Indonesia. To realize the AMI for smart grid, a strategy for selecting communication media based on geographic conditions becomes a challenge. In this study, the review of communication media parameters based on smart meter requirements is described. Grouped based on the distribution of customer characteristics in Indonesia. Customer characteristics are divided into 3 important aspects, namely customer density, geographical conditions, and building shape. It aims to get a two-way meter cluster with the best communication media performance. Finally, to simplify the selection of communication media, guidance is made in the form of a flowchart for the selection of communication media.
NB-PLC Performance Evaluation for Advanced Metering Infrastructure
Transmission and Distribution Department PLN Research Institute
Jakarta, Indonesia.

Abstract: Communication media is the main component of AMI (Advanced Metering Infrastructure). PLC uses the existing powerline infrastructure to transmit and receive the data from the end-user of the distribution network to the data concentrator unit before collected and processed in the data center. Attenuation and noise are affected the success rate of the PLC data communication process. In the residential area, attenuation is caused by the impedance of the powerline, and noise is mostly caused by the residential load noise. Therefore, in this study the consideration of narrowband PLC (NB-PLC) as AMI communication media are described and evaluation of NB-PLC performance tests are constructed. The effect of jointing and varying the length of the powerline conductor are evaluated. Moreover, the noise frequency is captured and analyzed using a spectrum analyzer and PLC sniffer to find the ideal frequency band for NB-PLC communication media.
Application of the Phase Shift Full Bridge Converter for the Single-Phase Full-Bridge Inverter to Improve the Output of the Renewable Energy

Thao Huynh Van¹, Thanh Le Van², Tuyet Mai Nguyen Thi³, Minh Quan Duong⁴, Le Xuan Chau⁵
¹²³⁴University of Science and Technology, The University of Danang Danang, Vietnam ⁵Naval Academy Vietnam Nhatrang Vietnam

Abstract: Today, renewable energy has been widely used for the purpose of creating an environmentally friendly electric energy source. Basically, the process of converting natural energy into electricity is done by using energy conversion engineering devices. However, electricity from renewable energy sources is mainly a one-way and unstable energy source that cannot be connected to the grid and is difficult to use directly. In this paper, we study and design a single-phase inverter capable of reversing 365VDC DC power from renewable energy sources into 220VAC AC power. At the same time, connect 220VAC power to the national grid 220-50Hz for consumption. A phase-shifted global converter with a phase-locked single-loop loop structure based on a T/4 transport delay block combined with an alpha-beta converter and a global inverter using Pulse Width Modulation monopole and proportional-resonant current controller are used in this inverter. We use MATLAB / SIMULINK software to simulate the whole system to determine the results.
Design of AC Electric Vehicle Supply Equipment based on Safety Standard

Khotimatul Fauziah¹, Yuli Astriani², Dionysius A. Renata³, Afrias Sarotama⁴, Agus Suhendra⁵, Eka R. Priandana⁶, Riza⁷
¹,²,³,⁵,⁶,⁷National Laboratory for Energy Conversion Technology BPPT Serpong, Indonesia ⁴Center of Technology for Electronics BPPT Serpong, Indonesia.

Abstract: Electric vehicle supply equipment (EVSE) is a battery charging system for electric vehicles (EVs). EVSE must be designed to refer to the applicable standards to ensure security and interoperability with various types of EV. This paper explains the design of EVSE for mode 3 AC charging station (CS) based on International standard IEC 61851-1. The design follows the safety requirements on IEC 61851-1, such as overvoltage, overcurrent, and residual current devices to protect persons against electric shocks. Moreover, the charge controller manages the functionality of the devices and their communication so that energy transfers safely. The EVSE is equipped with a human-machine interface (HMI) using Raspberry Pi as the central processor to communicate between CS and EV users. The open charge point protocol (OCP) is installed for communication between CS and the back-end system; thus, CS can be monitored and managed from the central system. The design is implemented for a 22 kW 3-phase AC EVSE and its testing result demonstrated a successful charging process to the commercial EV, Mitsubishi i-MiEV.
A Model Reference Adaptive System for Online Rotor Parameter Estimation of Induction Motors

Ikhwan Wiranata, Jihad Furqani, Arwindra Rizqiawan, Pekik Argo Dahono
School of Electrical Engineering and Informatics Institute Technology of Bandung Bandung, Indonesia.

Abstract: Induction motors are currently the workhorse of industry due to its simplicity, robustness, and relatively low cost. Performance degradation of induction motors significantly affects the total consumed energy including losses. The conventional approach is undesirable due to loss of productivity time imposed. Moreover, the operational condition is different between the conventional no-load and short-circuit test and the real loaded operation of induction motors affecting the accuracy of the actual parameter values. In this paper, a new method for estimating induction motor rotor parameters during loaded operation is proposed. The proposed method is based on a model reference adaptive system, where Newton-Raphson algorithm is utilized as the adaptive mechanism process. The proposed model automatically adapts the rotor parameters if mismatch between actual and estimation powers is existed. Experimental results are included to verify the proposed method which has convergence in 5th iteration and estimated rotor parameter error less than 1% due to work operations. The proposed method is successfully estimating the actual induction motor rotor parameters under various loading conditions.
Detection of Air Gap Eccentricity On Three-Phase Induction Motor Using 3-Axis Digital ELF Gaussmeter
Reza Sarwo Widagdo, Dimas Anton Asfani, I Made Yulistya Negara
Department of Electrical Engineering Institut Teknologi Sepuluh Nopember Surabaya, Indonesia.

Abstract: This paper presents air gap eccentricity detection performance using a 3-axis digital elf gaussmeter sensor on a three-phase induction machine. Most of the induction motor disturbances are related to eccentricity. In practice, static and dynamic eccentricities occur together. Therefore, it is necessary to have an early diagnosis or detection to deal with it to be detected and immediately corrected before a more serious problem occurs. The analytical approach for evaluating the performance of a three-phase induction motor under different eccentric conditions will be presented in this paper. The sensor used in this experiment is a coilshaped sensor that can pick up flux signals that deviate from 3 different magnetic axes, namely the X, Y, and Z axes. This sensor is placed outside the stator with a 2-3 cm distance to not interfere with motor performance. The Fast Fourier Transform (FFT) method analyzes the frequency spectrum of the stray flux. In this study, failure detection was done by comparing the frequency spectrum of the flux deviating in normal motor conditions with an eccentricity of 0.2 mm. The motor failure detection system, especially the eccentricity in the air gap, can anticipate fatal damage to the induction motor early. Experimental test results are introduced, including motors with air gap eccentricities as well as loading under unbalanced voltage conditions. Later, the stray flux on the three axes (X, Y, and Z channels) is measured and compared in the frequency domain. Detection of air gap eccentricity is easy to detect under balanced voltage conditions and no load, while in other conditions it is difficult to detect because it causes additional sidebands at the eccentricity frequency (fs ± fr).
Influence of Three-Phase Impulses with Different Sequences and Rise Times on Voltage Distribution Along the Stator Winding of Rotating Machines

Fan Qirui¹, Liu Xuezhong², Yuan Pengfei³, Zhang Yue⁴, He Mingpeng⁵, Hu Bo⁶
¹²³ State Key Laboratory of Electrical Insulation and Power Equipment Xi’an Jiaotong University Xi’an, China ⁴⁵⁶ Dongfang Electrical Machinery Co. Deyang, China.

Abstract: The highest amplitude and distribution characteristic of repetitive impulse overvoltage are need to be eliminated for ensuring the stability and reliability of the rotating machines. In this paper, in order to research the influences of PWM three-phase impulse sequences on the voltage distribution characteristic along the stator windings, a laboratory test platform with a 2.5MW permanent magnet synchronous generator under the excitation of a PWM inverter was set up, and a corresponding numerical calculation model was developed to represent these electrical behaviors. The repetitive impulses with different three-phase sequences were measured and calculated, respectively, to analyze their effects on the stator winding voltage distribution. Moreover, the rise time of three-phase impulses was also altered in the calculation model within a range from 0.2 to 2 microsecond to obtain the corresponding voltage distributions. The characteristics of coil (or turn) to ground, coil to coil and inter-turn voltage, respectively, along the stator winding were got and analyzed also.
Effect of Jump Voltage and Rise Time on the Temperature and Electric Field Distribution Along the Stress Grading System of An Inverter-fed Motor

Ping Liu¹, Xuezhong Liu², Qirui Fan³, Shaobo Huang⁴, Bo Hu⁵, Zhiming Liang⁶
¹₂³State Key Laboratory of Electrical Insulation and Power Equipment Xi’an Jiaotong university Xi’an, China ⁴⁵⁶Insulation Research Center Dongfang Electric Machinery Co. Ltd.

Abstract: This paper first built an inverter circuit which can change the number of cascaded units to obtain different multi-level voltage waveforms, such as 7-level, 9-level, etc. Secondly, a 2D axisymmetric model of the stress grading system of an 18kV inverter-fed motor was established, whose stress grading system includes the conductive slot coating and stress grading coating, named low resistance (LR) and high resistance (HR), respectively. A series of coupled electro-thermal simulations were carried out. The maximum electric field distribution, the average loss density, and the steady-state temperature rise along the low resistance and high resistance under different multi-level voltages were conducted, further, the influence of the rise time on the maximum electric field and temperature rise along the stress grading system was evaluated. The results show that when the jump voltage or the rise time increases, the maximum tangential electric field and the temperature rise on the low resistance is higher with the rise time increases while those of high resistance show a little increasing trend.
Tropical Lightning Strike Potential as a Cause of Oil Tank Fire in Indonesia

Farhan Hafiz Budisatrio, Bryan Denov, Suwarno, Syarif Hidayat, Wisnu Adyatma S, Reynaldo Zoro
School of Electrical Engineering and Informatics, Bandung Institute of Technology, Bandung Indonesia

Abstract: Indonesia is located in a tropical region and has a high number of lightning flash density. In 2021, the latest oil tank fire incident in Balongan and Cilacap, Indonesia, caught the attention of lightning engineers. The oil and gas industry in Indonesia, in general, implements international standards related to lightning protection, such as the NFPA and API standards. However, due to the difference between lightning characteristic in tropical and sub-tropical area, the oil tank and refineries in the tropical area are not inherently self-protected against lightning direct strikes. Oil and gas industries in tropical area requires additional lightning protection to prevent direct lightning strikes on tank wall, breather valve, and automatic tank gauging (ATG). Based on lightning characteristic in general, lightning can melt oil tank, causing the tank to leak. The voltage difference between the tank wall and the floating roof can cause sparks, then leads to the occurrence of fire. This paper discusses the potential of lightning strike that causes fire tank, including the existence of international standard in tropical area, and the solution of lightning threat, based on captured lightning data.
Observed Acoustic Radiation of Thunder Using Microphones Array
Ariadi Hazmi
Dept. of Electrical Engineering, Universitas Andalas, Indonesia

Abstract: Lightning discharges can produce electromagnetic fields, light and thunder (shock waves). Thunder can be defined as the acoustic emission associated with all impulsive processes in cloud-to-ground (CG) and intra-cloud (IC) flashes, including M-component type processes. The acoustic signature of thunder can be used to better understand some of the properties of the lightning channel. Acoustic signatures generated by lightning flashes have been analyzed in the time domain in many previous studies for the quantitative identification of thunder features. To strengthen the previous findings, the acoustic signal frequency of a close flash and a distant flash were analyzed using the Fast Fourier Transform (FFT), the Short-time Fourier Transform (STFT), and instantaneous frequency. The results showed that there were differences between the frequencies of both flashes. The frequency of the acoustic signal of the close flash was higher than that of the distant flash. The frequency ranges of the acoustic signals of the close flash and the distant flash were 300 to 700 Hz and 100 to 400 Hz, respectively.
Analysis of Corona Characteristics of HVAC and HVDC in a Simulation Environment

Sasindu Thennakoon¹, Dinuka Dilshan², Ruwansi Kaldasani³, Rasara Samarasinghe⁴, Rohan Lucas⁵
¹,²,³,⁴ Department of Electrical Engineering, University of Moratuwa, Katubedda, Sri Lanka ⁵Department of Electrical, Electronic & Telecom. Engineering, General Sir John Kothalawala Defence University, Rathmalana Sri Lanka

Abstract: Corona is a major problem in high voltage applications. It is an electrical discharge caused by the ionization of air at atmospheric conditions in a non-uniform electric field. Corona is responsible for power loss in transmission lines, give rise to radio interference. Much experimental and theoretical research have been done to identify the characteristic of corona discharge. This paper analyzes the impact of various parameters on Corona onset voltage, and magnitude of Corona current. It obtains the Corona signal from different conductor distances and different configurations with HVAC and HVDC. The different configurations namely rod-rod, rod-plate, plate-plate are modelled in 3D using ANSYS Maxwell package. The applied voltage to the electrodes is varied and uses the ANSYS simulation results to identify the corona inception. A numerical analysis is done, and a method is proposed for the calculation of Corona current. A model is developed using MATLAB Simulink package to obtain the behavior of Corona current and its impact on output voltage of HVAC and HVDC systems.
Analysis of Currents in Dielectric Gloves due to Medium Voltage Surges

John Morales¹, Flavio Quizhpi-Palomeque², Mateo Quizhpi-Cuesta³, Francisco Gómez-Juca⁴, Byron Cabrera R⁵, Victor Humala A⁶

¹Instituto de Energía Eléctrica, Universidad Nacional de San Juan. Energy Research Group (GIE), Universidad Politécnica Salesiana, San Juan 85407, Argentina
²³⁴Energy Research Group (GIE) Electrical Engineering Career, Universidad Politécnica Salesiana, Cuenca Equador
⁵⁶Electrical Engineering Career, Universidad Politécnica Salesiana, Cuenca Equador

Abstract: Dielectric gloves are used by technicians to carry out work on Medium and High Voltage air lines. It is necessary to carry out electrical tests to safeguard the integrity of the person who is using them, if the leakage current exceeds 20 mA, harmful effects on the user’s health may occur. In the present article, a method for the measurement of the leakage current with the implementation of an aluminum hand as a test electrode is presented. The test results are compared with the conventional method proposed by the ASTM D120 standard. The results show that the leakage currents recorded in the aluminum hand were lower in relation to the standard method. The currents registered before the glove was pierced are less than 30 mA, and the breakdown voltage was lower than that established by the standard. The work presents an alternative to verify the state of dielectric gloves.
Verification and Calibration of Impedance Measuring Instrument
Ilham Muliawan Hamzah, Syarif Hidayat, Bryan Denov
School of Electrical Engineering and Informatics, Institut Teknologi Bandung, Bandung, Indonesia.

Abstract: This paper covers a method of measurement by injecting impulse current wave. This method measures a variety of parameters namely impulse impedance, inductance, resistance, and peak impedance. The result of the tests shows that the measurement contains a decent amount of error and therefore need a correction factor. This paper will discuss about the calculation of correction factor for each wave front by comparing lab results with the actual value. The factor is then validated by using PSIM software and tested on DSDC cable. The usage of correction factor increased measurement accuracy by 90%. Impulse injection with 5.28 μs rise time has the smallest error percentage that is 2.67%.
A Simulation Study on Lightning Current Distribution in Telecommunication Tower
Bryan Denov, Syarif Hidayat, Suwarno, Reynaldo Zoro, Syadila Refiasto, Farhan Hafiz Budisatrio
School of Electrical Engineering and Informatics, Institut Teknologi Bandung, Bandung, Indonesia.

Abstract: Direct lightning strikes to a structure are always a problem in the study of electrical protection systems. So, a study is carried out regarding the impact of a direct lightning strike on a structure. A complex structure will be an important issue in designing an effective lightning protection system and attaching a protection mechanism to the components to protect. In the present study, the effect of a direct lightning strike on a structure will be studied based on the distribution of surface currents and the intensity of the electric field using the electromagnetic computational method (Hybrid FEM / MoM) approach based on software simulation. The simulation is carried out by modeling two parameters, namely modeling lightning currents and modeling structures. The lightning current modeled has an amplitude of 40kA with a working frequency of 833.33 kHz, this is based on the IEC 62305 standard where the maximum current occurs when the lightning current wave reaches a face time of 1.2μs. In this study, Finite Difference Time Domain (FDTD) and Method of Moments (MoM) software can be used to model lightning strikes on a 75 m high telecommunications tower with lightning strike settings based on tropical lightning condition. The tower model used is without using a down conductor and using a down conductor. This research has a contribution in showing the distribution of lightning current that flows in the foot of tower and down conductor when tower is struck by lightning.
Development of Overhead Transmission Line Assessment Index
Rofiul Huda¹, Rahman Azis Prasojo², Suwarno³, Rizally Priatmadja⁴
¹,²,³ School of Electrical Engineering & Informatics Institut Teknologi Bandung, Bandung, Indonesia; ⁴Central Java Transmission Central Unit PT PLN (Persero) Bandung, Indonesia.

Abstract: The transmission line is an essential aspect of the electric power system as a medium to transmit electrical energy from the power center to the distribution system. The existing transmission line assessment index is not optimal because it does not consider the measurement values carried out in the inspection method. Therefore it needs a suitable way to reflect the reality of its condition. AHP was developed based on expert opinion in several previous studies to establish parameter prioritization. Multi-expert can help the system evolve. To obtain the consensus matrix, a row geometric mean approach was applied. The consensus methodology for numerous experts in power transmission line assessment index weighting factor calculation using AHP was employed in this study. As a result, the main component factor is the most critical factor for transmission line condition with a weighting value is 0.429, followed by Environment Assessment and Supporting Component Factor. Transmission assessment index calculations were done to 200 samples of transmission line towers. The results show that 71% or 152 transmission line towers are in good condition, while 29% or 48 others are in caution. The correlation between parameters was observed. It can be concluded that the higher the impact of environmental assessment, the lower the assessment index value.
High Voltage Conductor Effect Estimation on The Nearby Buried Piping System
Dimas Aji Nugraha, Guntur Supriyadi, Aji Suryo Alam, Joko Hartono, Hakim Habibie HU
Transmission and Distribution Dept, PLN Puslitbang Jakarta, Indonesia.

Abstract: Nowadays, space between utility and industrial infrastructure has become closer and closer due to the shortening of land availability. In those circumstances, the possibility of a new HV line will be installed near another facility like the mining area, industrial area, and business area will increase. This issue needs to be considered carefully since HV lines could affect the metal structure near them. HV lines can induce voltage to the metal structure nearby, causing AC stray current flow that leads to corrosion acceleration in the structure and also leave a potential shocking hazard to human and animal around the metal structure. Hence, a calculation of the affected effect by the HV line needs to be conducted to plan proper mitigation. This paper introduces a simple method to calculate induced voltage to the structure nearby. It is developed to estimate induced voltage in a piping system near the upcoming plan to energize a newly installed HV line in Jakarta.
A Study on Bending Properties of CTCs in Hot State
Shuqi Zhang¹, Zuoxian Wang², Zhengyu Xu³, Na Chai⁴
¹,²,³China Electric Powe Research Institute, Beijing, China ⁴Shenyang Hongyuan Magnet Wire Co.,Ltd. Shenyang, China

Abstract: Power transformers generally rising ability of anti-short circuit with epoxy CTCs, but the bending properties of epoxy CTCs haven’t been clear in the hot state. Therefore, a test method for the bending properties of the conductors under hot conditions is proposed. The 4 groups of CTCs with typical structures are tested in the radial and axial. Factors such as stabilizers resist the influence of bending performance. The effects of different temperatures, numbers of conductor cores and whether with a inter leaving paper on the bending properties were analyzed. The results show that: (1) when the temperature is increased from 90 °C to 105 °C, the axial and radial bending properties of epoxy CTCs decrease by 25% and 70% on average; (2) As the number of enameled rectangular copper conductors increases from 15 to 35, its radial and axial bending properties increases by up to 2.7 and 3 times respectively; (3) Between 20°C and 90 °C, the axial bending properties of the conductors without interleaving paper is twice than the conductors with interleaving paper. In addition, the correction method of the bending coefficient of the conductor is discussed. The results provide a more scientific basis for technical personnel to judge the bending properties of power transformers.
Characterization of Glow Plasma Treatment on Silica Nanofillers Under Different Treatment Durations

N. M. Saman¹, M. H. Ahmad², Z. Buntat³, Z. Adzis⁴, Z. Nawawi⁵, M. A. B. Sidik⁶, M. I. Jambak⁷
¹²³⁴ Institute of High Voltage and High Current, School of Electrical Engineering, Universiti Teknologi Malaysia, Johor Bahru, Malaysia.
⁵⁶⁷ Department of Electrical Engineering, Faculty of Engineering, Universitas Sriwijaya, Ogan Ilir, South Sumatra, Indonesia.

Abstract: Silica nanofiller or nanosilica is known to be one of the most widely used fillers in polymer nanocomposite. Nevertheless, agglomeration of nanosilica within polymer matrix has been discovered to be a limitation towards enhancing the insulating properties. With this regard, plasma discharge is found to have a great potential in overcoming the agglomeration of nanofiller despite using chemical solvents or coupling agents. The effectiveness of plasma treatment in functionalizing the nanofiller is influenced by few factors, including treatment duration. However, the optimum treatment duration is still yet to be explored to determine its effect on the morphology characteristic of nanofiller. Therefore, this study investigates the effect of plasma treatment duration on nanosilica by varying the treatment times to 1, 3, and 5 minutes. The glow mechanism of plasma discharge is produced by exhilarating the plasma reactor with 0.5 kV and 20 kHz of source parameters. The characteristics of plasma discharge are analyzed according to the discharge current and the properties of the Q-V Lissajous figure. In comparison, the morphology of nanosilica is characterized by using a Perkin Elmer FTIR spectrometer. The result showed that the plasma treatment duration is proportional to the intensity of the hydroxyl group functionalized on the nanosilica morphology with the highest intensity at 5 minutes of treatment time.
Aging Behavior of Mineral Oil, Gas-to-Liquid (GTL), and Natural Ester Liquids in Presence of Cellulosic Materials
Mawla Ahmad, Ilhamid Daris, Hardiansyah Rahmat, Suwarno
School of Electrical Engineering and Informatics, Bandung Institute of Technology Bandung, Indonesia.

Abstract: This research aims to study the aging behavior of mineral oil, Gas-to-Liquid, and natural ester oil on oil paper insulation. Experiments were carried out on oil insulation, which contained paper insulation, namely kraft paper (TUK), kraft paper (KP), pressboard (PB). Then the oil-paper insulation was placed in a sealed glass bottle & accelerated thermal aging for 1344 hours at a temperature of 150 °C. Observation of oil behavior was carried out at 336 hours intervals during aging. The aging behavior of the oil was observed by testing the oil moisture content, total acid number, breakdown voltage, color scale, interfacial tension, flash point, and Fourier Transform Infrared (FTIR). It was found that natural ester oil had better electrical performance than mineral oil and GTL. Meanwhile, natural ester oils due to their polar nature have different trends in both moisture and acid content when compared to hydrocarbon-based oils. It can be observed there is a relationship between moisture content, acidity, and breakdown voltage in all oils. The color scale shows changes with aging of the three oils, as well as the interfacial tension. Meanwhile, flash point shows the superiority of natural ester oil and GTL has a greater value than mineral oil. FTIR shows the occurrence of transesterification in natural ester oil in the 1700-1800 cm⁻¹ spectrum where in mineral oil and GTL this is not found.
Mitigation of Insulator Ultraviolet Emission Measurement Errors using Facular Area
Tumiran\textsuperscript{1}, Mochammad Wahyudi\textsuperscript{2}, Noor Ahmad Setiawan\textsuperscript{3}, Faiq Arkan Dewanto\textsuperscript{4}, Kukuh Pambudi\textsuperscript{5}, Dharma Saputra\textsuperscript{5} \textsuperscript{1,2,3,4}\textsuperscript{Department of Electrical and Information Engineering, Universitas Gadjah Mada Yogyakarta, Indonesia} \textsuperscript{5,6}\textsuperscript{PLTU Jawa Tengah 2 Adipala Indonesia Power Company Cilacap, Indonesia}

Abstract: The use of an ultraviolet (UV) imaging camera is very useful in evaluating insulator conditions since it can detect pre-breakdown phenomena and inform their location. However, the accuracy of UV count measurement, as a quantitative indicator that can be read directly on the camera screen, is greatly influenced by how the operator conducts the data recording on the observed insulator. This paper reported the presence of human error in UV count measurement. Furthermore, the facular area was applied to be compared with the UV count. The discharge phenomena were generated through various experiments. The results showed that the application of facular area was able to evaluate the insulator condition more accurately if it was compared to the UV count when the data recording was conducted incorrectly. In this case, there was no doubt when the quantitative results were related to the qualitative results.
Application of Online PD Monitoring System Based on Large-scale Distributed Detection on High Voltage Cable Line
Min Chen¹, Koji Urano², Zhipeng Zhou³, Jingjing Lu⁴, Yingying Liu⁵, Yanting Xie⁶
¹.².³.⁴ Technical department SE Technology Limited Hong Kong, China
⁵.⁶ Technical department ZF Technology Limited Guangzhou, China

Abstract: Online partial discharge (PD) monitoring system for high voltage power cable lines is different from that for other power equipment like GIS or transformer. For cable lines, the PD can be detected at cable joint and termination. Since the PD signal must decay when it propagates along the cable, distributed PD detection can increase the detection sensitivity. PD sensors and local signal processing units must be installed at each cable joint and termination, spreading over the whole cable line of several kilometers or more than ten kilometers. Therefore, all detected signals from each sensor point must be collected to the centric signal processing stage for displaying, analysis, judgment, and alarming via fiber network or wireless communication. The PD online system to operate effectively and reliability for years also required some necessary automatic-measurement functions such as auto-change of different noise filters, synchronous PRPD pattern comparison, PD identification, PD localization, and periodic system self-checking. This paper gives an example to illustrate the practical application of online PD monitoring technology for a large-scale online PD monitoring system installed on a pair of 16km-500kV XLPE cable transmission lines.
Partial Discharge Characteristics of Low-Density Polyethylene Nanocomposites Incorporated with the Plasma-treated Silica and Boron Nitride Nanofillers

N. M. Saman, N. A. Awang, M. H. Ahmad, Z. Buntat, Z. Adzis
Institute of High Voltage and High Current, Universiti Teknologi Malaysia, Johor Bahru, Malaysia

Abstract: One of the criteria used to evaluate the improvement of the polymer's insulating property when nanofillers are introduced is partial discharge (PD). Nevertheless, the agglomeration of nanofillers within the polymer matrix is the key issue that prevents the insulating characteristics from improving. In light of the aforementioned, a variety of surface modification approaches have been developed to prevent nanofiller agglomeration. Plasma treatment is another emerging approach that has the potential to improve nanofiller compatibility with polymer matrices by altering the surface of the nanofillers. It is therefore necessary to investigate the efficiency of plasma treatment in improving the partial discharge properties of Low-density Polyethylene (LDPE) nanocomposites. In this study, the PD measurement according to the IEC 60270 standard has been conducted to characterize the PD endurance of the LDPE nanocomposites filled by different loading of plasma-treated silica (SiO2) and boron nitride (BN) nanofillers. The PD was measured using a CIGRE method (II) test cell. The phase-resolved partial discharge (PRPD) pattern diagram, the maximum PD magnitude, and the total PD number were used to examine the PD characteristics. The results showed that the 30-minutes plasma-treated nanocomposites had the greatest improvement against the PD activities with the lowest PD magnitude of 513 pC. Besides, it was found that the LDPE/SiO2 nanocomposites exhibited a significant improvement of the PD resistance compared to the LDPE/BN nanocomposites.
Enhancement of Electrical Treeing and Partial Discharge Characteristics of Silicone Rubber Filled with Silicon Nitride Nanoparticles

Institute of High Voltage and High Current, School of Electrical Engineering, Faculty of Engineering, Universiti Teknologi Malaysia, Johor Bahru, Johor, Malaysia.

Abstract: Silicone rubber (SiR) is widely deployed as a high voltage electrical insulating material when compounded with nanofillers. Nanofillers have been introduced into the SiR matrix to prevent such long-term degradation known as electrical treeing. To date, studies on SiR nanocomposites have been intensively conducted incorporating nanofillers from silicon oxide-based. However, only limited studies have reported the electrical tree characteristic correlated with partial discharge (PD) activities in SiR filled with silicon nitride (Si3N4) nanoparticles. Thus, this study explores the collective gap by characterizing the prolongation of electrical treeing that correlates to the SiR nanocomposites' PD activities filled with Si3N4 nanoparticles. The treeing experimentations were conducted by applying 12 kVrms of 50 Hz AC alternating voltage on the specimen of SiR nanocomposites filled with 1, 3, and 5 weight percentages (wt%) of Si3N4. All the treeing specimens were prepared based on the leaf-like configuration involving a needle-plane electrode arrangement. The electrical treeing growth was analyzed according to the tree initiation time, tree propagation time, growth rate, and tree breakdown time associated with the PD activities. The outcome from this study found that the SiR/Si3N4 nanocomposites were able to withstand the electrical tree growth better than the pure SiR. It can be summarized that the existence of nanoparticles inside the SiR matrix governed the pattern of electrical treeing growth to become a more zig-zag-like structure. Meanwhile, SiR nanocomposite filled with 5 wt% of Si3N4 showed the most effective configuration of nanocomposite with the highest number of branches and the longest time interval for the sample to reach the bridging phase.
Ultra High Frequency Partial Discharge Sensors based on Various Microstrip Patch Antenna Designs
S. Jaruman, N. M. Saman, H. C. Xiang, M. H. Ahmad, Z. Buntat, Z. Adzis
Institute of High Voltage and High Current, School of Electrical Engineering, Faculty of Engineering, Universiti Teknologi Malaysia, Johor Bahru, Johor, Malaysia.

Abstract: The most common pre-breakdown phenomenon in high voltage (HV) equipment is partial discharge (PD). The presence of PD activity is a warning indicator that the insulation deterioration would worsen over time, leading to catastrophic failure if the associated defects are not addressed early. Ultra-high frequency (UHF) has been proposed as a non-conventional method for detecting PD because of its resilience to external noise, high sensitivity, and online measurement potential. The UHF detection approach uses sensors to detect electromagnetic waves emitted by the PD source. The sensor is thus one of the most important parts of UHF PD detection. Microstrip patch antenna is widely used as a UHF sensor due to its merits of simple structure, compact profile, low cost, and ease of fabrication. This project deals with the development of the microstrip antenna for PD detection. To evaluate the antennas' performance, five antennas are built and simulated using Computer Simulation Technology (CST) Microwave Studio software. Return loss, voltage standing wave ratio (VSWR), and surface current are among the simulated results. These five antennas operate in the range of at least 80% of UHF and have the acceptable size that can be installed on the dielectric window or mounted on the flange.
Abstract: Partial discharge is a localized electrical discharge that only partially bridges the insulation between conductors and can or cannot occur adjacent to a conductor. In the manufacture of a PD detector, several steps need to be carried out, such as circuit simulation, dynamic characteristic testing using Vector Network Analyzer (VNA), and partial discharge measurement testing. In addition to these three stages, it is also necessary to calibrate the detector using a charge calibrator to find the charge measured by the detector during the PD measurement test. Dynamic characteristic testing using VNA and detector calibration will be the main focus of this paper. In this research, three detectors will be tested, namely a detector with an impedance value of 3dB (detector A), a detector with an impedance value of 4dB (detector B), and a detector with an impedance value of 5dB (detector C). In the VNA test, the gain and the return loss of the detector are measured. Meanwhile, in calibration using a charge calibrator, a relationship between the charge and the voltage generated by the detector will be obtained. The voltage shown in the calibration of the PD detector will be greatly influenced by the gain of each detector. Based on the VNA test results, detector A has the largest gain with a gain of 12dB, then detector B has a gain of -13dB, and detector C has a gain of 10dB. The calibration is done by giving an impulse signal with a fixed charge of 100pC, 1nC, and 10nC. Based on the calibration results, the voltage measured by the detectors is different. The largest voltage is generated by detector A and the smallest voltage value is generated by detector B.
Study of Antenna Development for Partial Discharge Measurement
Umar Khayam, Farradita Nugraha
School of Electrical Engineering and Informatics, Institut Teknologi Bandung, Bandung, Indonesia.

Abstract: This paper discusses the study of antenna development for partial discharge measurement, which has been conducted in the Laboratory of Voltage and High Current, School of Electrical Engineering and Informatics, Bandung Institute of Technology. This paper was created to find out the most effective shape of antenna as a partial discharge detection sensor. In the design of the antenna, there are simulation antenna, print the antenna on the PCB, and experiments using VNA-Vector Network Analyzer. In the simulation of the antenna, the application used is Ansoft HFSS. In the design, there are substrates, antenna patches, and ground with thickness and materials that are adjusted to the needs of each antenna. After simulating the antenna on Ansoft, then the antenna is printed on the PCB, for further experiments using VNA. The results of simulations as well as from experiments are compared. In antenna design, there are antenna parameters that need to be considered, including bandwidth, voltage standing wave ratio (VSWR), and return loss. From the antenna experiments that have been done in the laboratory, the most effective antenna is obtained as a sensor. It is found that the bowtie antenna with modifications at the end, the dipole antenna with the stub, and the Hilbert 3rd order fractal antenna, are the best antenna of all antennas.
Power Transformer Oil Measurement Prioritization based on Technical and Economic Criteria using Analytic Hierarchy Process
Rahman Azis Prasojo, Heri Sutikno, Suwarno, Nur Ulfa Maulidevi, Bambang Anggoro Soedjarno P.
School of Electrical Engineering and Informatics, Institut Teknologi Bandung, Bandung, Indonesia
PT. PLN (Persero) Bandung, Indonesia

Abstract: The condition of power transformer oil-paper insulation system is being monitored through oil testing and measurements. Due to power transformer's importance, these measurements are held once a year, or more if needed. They comprise of many parameters, such as dissolved gasses, oil dielectric characteristics, and furanic compounds. Health Index approach is commonly used to aggregate those parameters into single value. With more complete parameter, more accurate Health Index can be obtained, however, the cost will also be higher. This paper discusses the parameter prioritization based on technical and economic criteria. The technical criteria consists of parameter measurement reliability, criticality, and Health Index accuracy reduction when the parameter is unavailable. The economic criterion is the cost to obtain each parameter. Analytic hierarchy process approach was used to compare those parameters and rank the priority.
Experimental Setup for Ferroresonance Initiation On 3-Phase Low Voltage Transformer

I Gusti Ngurah Satriyadi Hernanda, I Made Yulistya Negara, Dimas Anton Asfani, Daniar Fahmi, Naoki Satryo Anggito, Chairul Bahy
Electrical Engineering Department, Sepuluh Nopember Institute of Technology, Surabaya, Indonesia.

Abstract: Ferroresonance is a phenomenon that arises because it is triggered by a transient condition such as a switching, lightning strike, or short circuit disturbance. This phenomenon produced an abnormal form of voltage and overcurrent. It is caused by a non-linear inductance component (L), resistance component (R) and the capacitance (C) is constant in a system. In this study, the design and implementation of a ferroresonance test module on a low-voltage 3-phase transformer are made to physically analyze the small-scale ferroresonance phenomenon based on conditions in the system/field. The test results show that the design of the test module that is made can function correctly. The test module can produce a ferroresonance response in a 3-phase transformer with H and M cores. H and M cores are types of iron cores from the transformer used in this study. The test is carried out by increasing the power supply voltage until it reaches the transformer voltage rating and then varying the phase discharge and capacitor value to raise a ferroresonance response. The phased release variation is the release of 1 phase and 2 phases with capacitors variations of 10μF, 20 μF, and 30μF in series and series-parallel configurations. The ferroresonance response of the voltage wave obtained in the series-parallel configuration produced a more distorted wave than the series. Based on the test results, when testing with various capacitors, the greater the value of the capacitor, the greater the voltage required to generate the ferroresonance response, and Cseries has a more dominant influence than Cparallel. It takes a more significant value of the series capacitor (Cseries) to reduce the power supply voltage needed to get a ferroresonance response with a decrease of up to 28%.
Early Warning of XLPE Power Cable Breakdown by Using Partial Discharge Testing

Fabianus Marintis Dwijayatno1, Tessamonica Luthfia2, Nelson Silaen3, Ahadiyat4

1Substation and GIS Assesment Department PLN UIT JBT, Bandung, Indonesia; 2,3,4 Planning and Evaluation Department PLN UIT JBT Bandung, Indonesia;

Abstract: In a substation, the power cable in the transformer serves to deliver low voltage (20 kV) to the incoming cubicle so that it can be distributed to the feeder. The reliability of the power cable is needed to maintain the continuity of electricity distribution. The type of power cable that is mostly used at PLN is the XLPE type, where at PLN itself this cable is only tested for insulation resistance. Insulation resistance is a test that is included in the shutdown measurement category which is carried out only once every 2 years. By only relying on insulation resistance testing, it is considered very lacking to be able to determine the performance of the power cable. Partial Discharge is localized electrical discharge that only partially bridges the insulation between conductors and which can or can not occur adjacent to a conductor. Partial Discharge can result in a breakdown of the transformer power cable if left continuously. Partial Discharge that occurs in the power cable produces several products including electromagnetic, acoustic & gases. Electromagnetic and acoustic can be captured by the test equipment to determine the presence or absence of partial discharge. By testing Partial Discharge abnormalities that occur in the power cable can be detected and used as an early warning before a breakdown occurs.
Design of a Rectangular Microstrip Patch Antenna as UHF Sensor for Partial Discharge Detection on Power Transformer
Jean Pierre Uwiringiyimana, Suwarno, Umar Khayam
School of Electrical Engineering, Institut Teknologi Bandung, Bandung, Indonesia

Abstract: Partial discharge (PD) phenomenon in high-voltage (HV) apparatus is a warning symptom of insulation degradation that can eventually lead to equipment breakdown. The ultra-high frequency (UHF) or electromagnetic method has been widely adopted to monitor the insulation condition of HV power equipment such as power transformers. To detect PD occurrence on HV power transformers, the UHF method is preferable due to its high immunity to external interferences such as background noise and electromagnetic interferences from telecommunication. The UHF antennas are used in the UHF method to detect the electromagnetic waves emitted by PD events inside the power transformer tank. Many studies about the design of UHF antennas to detect PD on power transformers have been conducted previously. However, these UHF sensors are still facing noise disturbances especially for on-line partial discharge measurement, in presence of high noise levels. To address interference issues affecting the UHF sensor sensitivity, this paper presents a novel UHF PD sensor called rectangular microstrip patch antenna or simply patch antenna. This type of antenna has a simple structure, low cost for fabrication, and ultra-wideband (UWB) frequency enabling it to detect PD signals in a wide frequency range within the UHF range (300MHz-3GHz). To design, simulate and optimize the UHF antenna, the HFSS software was used. The FR4-epoxy substrate having a thickness of 1.6mm, and a dielectric constant of 4.4 was used to design and simulate this rectangular patch antenna. The perfect electric conductor (PEC) was used on the rectangular patch, feedline, and ground plane of the designed patch antenna. The proposed antenna has a low reflection coefficient, low VSWR < 2, a wide bandwidth, as suitable gain, and directivity enabling this antenna to be a suitable and promising sensor for PD detection on power transformers.
Special Protection System (SPS) Designing and Testing Based on Vulnerability and Frequency Security Index: Case Study of Batam-Bintan System, Indonesia

M. Rivandi Fadli, Kevin Marojahan Banjar Nahor, Nanang Hariyanto, Rizky Rahmani, Fathin Saifur Rahman
Electrical Power Engineering, School of Electrical Engineering and Informatics, Bandung Institute of Technology, Bandung, Indonesia

Abstract: This paper will be focused on designing Special Protection System (SPS) for Batam-Bintan System in Indonesia. This study will conduct a method to design event-based and parameter-based SPS based on identified vulnerable points. The designed algorithm will be tested to the 24 hours load curve in a weekday and a weekend. Frequency Security Index (FSI) will be a main indicator to compare performance between SPS and existing protection scheme. From calculation, there are identified 8 contingency points that have a significant difference in vulnerability index (Vu) when compared to the Vu value during the normal operating conditions. After design process of SPS based on power balance between generation and load is conducted, the suitable algorithm for the loss of generator block is event-based and for the loss of lines is parameter-based. This paper also conducts a method to find an arming value for parameter-based algorithm based on frequency response after disturbance. From the simulation results, SPS could improve the FSI value of Batam-Bintan System for each vulnerable test point. It can be concluded that SPS could accelerate the power balance in the system, thus frequency stability can be achieved faster.
Real Time Simulation of New Defense Scheme Based on Centralized Remedial Action Scheme For Batam-Bintan Electrical System Implementation

Nuel Yosia, Kevin Marojahan Banjar Nahor, Nanang Hariyanto
Electrical Power Engineering, School of Electrical Engineering and Informatics, Bandung Institute of Technology Bandung, Indonesia.

Abstract: System reliability is the main factor that is maintained in the continuity of the electricity system operation. In the event of a major disruption to the power system, a defense scheme can work quickly and safely to restore the system. Existing defense systems and disruptions that can lead to instability consist of UFLS, OGS, and other schemes. This scheme describes the design of the Centralized Remedial Action Scheme for the existing scheme implemented in the defense scheme in the Batam-Bintan system. The CRAS scheme will use the HYPERSIM simulator with OPAL-RT as Hardware In The Loop to perform real-time simulations, the SEL-3530 RTAC as the main processor for the RAS algorithm, and SEL 751 as the mitigation relay IED to send digital output CB commands back to HYPERSIM, where all security equipment will be connected using an ethernet cable and communicated using the IEC 61850 GOOSE Protocol. The 8 types of vulnerability in the system are implemented as an event-based algorithm that immediately executes through critical component CB status information, which is then effectively mitigated by using load shedding and generation steps. The results obtained are 8 types of vulnerability that can be overcome by minimizing load discharges or generations curtailment by equalizing the power deficit. The system frequency value can stabilize again within 5-8 seconds of the disturbance, and the transient response can return to a stable state value of 50 Hz. CRAS schemes can also be run by equipment with a duration of 30-40 ms from the start of the fault event to the CB opening command.
Interarea-Oscillation Damping with Dual Power Oscillation Damping Controller of a Utility-Scale Wind Power Plant
Mayur Basu, Jinho Kim, Robert M. Nelms, Eduard Muljadi
Electrical and Computer Engineering, Auburn University, Auburn, USA

Abstract: This paper investigates the potential of a utility-scale wind power plant (WPP) as a power oscillation damping (POD) controller to improve the system’s dynamic response to inter-area oscillation, especially with high-renewable and low-inertia systems. Type IV based WPP utilizes active power (P) and reactive power (Q) controls simultaneously by adding two separate P-based and Q-based PODs to the machine-side converter (MSC) and grid-side converter (GSC), respectively. For the P-based POD, the kinetic energy of the wind turbine is utilized according to an estimated power angle. It mitigates the necessity of any curtailment of active power for damping. For the Q-based POD, the Q reference is adjusted according to the rotational speed of a synchronous generator. During the damping control, a higher priority is given to P control in both of the MSC and GSC controllers. This paper uses the local bus angle and speed of the nearest synchronous generator as the feedback for each of these loops. The effectiveness of the proposed control scheme is verified with a three-phase short circuit fault in a two-area power system. The proposed method is also compared with the conventional technique to investigate the superiority of the proposed controller.
Simulation and Prevention of Indonesia Southern-Middle Sumatran West Ring Grid Power Swing Phenomena when Open Looping
Dispriansyah\textsuperscript{1}, Agustriadi\textsuperscript{2}, Agus Trimanto\textsuperscript{3}
\textsuperscript{1}Transmission and load control center PT PLN (Persero) P3B Sumatera Pekanbaru, Indonesia \textsuperscript{2}Operation System PT PLN (Persero) P3B Sumatera Pekanbaru, Indonesia \textsuperscript{3}Transmission Academy PT PLN (Persero) UPDL Semarang Semarang, Indonesia

Abstract: The distance of the load center from the power plant causes the regional power balance of the electric power system to not be achieved. This results in high power transfer between subsystems. The high-power transfer will be a problem when there is interference or open looping in the ring network because it has the potential to cause system instability and the impact of blackouts is quite large. The experience of the open looping disturbance on the Southern-Middle Sumatran Power System that which gives rise to a power swing is modelled and presented. The root causes of instability when open looping is analyzed. Finally, corrective actions such as a Remedial Action Scheme (RAS) with Generation Shedding (OGS) and Load Shedding (OLS) to damp the power oscillation when open looping occurs are simulated, obtain satisfactory results in preventing system instability and avoid blackouts.
Static Security Assessment using Random Forest Based on Digsilent-Phyton Simulation
Eko Agus Murjito, Kevin M. Banjar-Nahor, Rizky Rahmani, Fathin Saifur Rahman, Nanang Hariyanto
Electrical Power Engineering, School of Electrical Engineering and Informatics, Bandung Institute of Technology, Bandung, Indonesia.

Abstract: An electric power system is expected to continuously operate in safe conditions at all times and in all configurations. Modern electric power systems have dynamic characteristics with varying generation compositions, load types and network topologies. The dynamic changes of the electric power system require a fast, accurate, and efficient power system operation assessment. Conventional power system assessment mechanism is carried out by simulating contingency analysis with sampling testing on the network topology and generation and load profiles. Its processes also depend on the operator’s expertise and experience in analyzing simulation data results, involving many variables and parameters. It is a time-consuming process and has a potential of human error. This gap can be reduced with random forest approach in power system assessment. Digsilent Power factory and python software are used for efficiently generating normal operation and N-1 contingency load flow simulation data with different loads: 50%-150% from the baseload as the datasets. The datasets are then used for training models based on a random forest algorithm for assessing the power system operation status. Finally, the proposed method will be tested on IEEE 14 and 39 test systems with various types of datasets training data to measure the level of accuracy and error proposed model. The simulations have shown that the proposed method has an MSE value of 0.0007 and 0.0005 for static security index prediction on IEEE 14 and IEEE 39, respectively and has an accuracy value of 100.0% and 99.97% for static security operation status classification on IEEE 14 and IEEE 39, respectively. With this level of accuracy, the proposed model may serve as a useful and efficient tool for power system assessment.
Implementation of Auto Reclose for Combined Overhead Line with Underground Cable using Distance Relays. A case study at Gajah Tunggal 150kV Substation
Hikmah Prasetia, Amdi Nopriansyah, Yudha Nugroho
PT PLN (Persero) UIT Jawa Bagian Barat Jakarta, Indonesia

Abstract: More than 70% of fault incidents on overhead lines are temporary faults. Thus it needed to put auto-reclose as a protection scheme to maintain continuity of transmission supply when there is a temporary fault on overhead lines, such as kite, tree, or lightning. While on underground cable, the occurrence of a fault is must be permanent. Therefore auto-reclose is not applied on underground cable. Gajah Tunggal 150kV substation is supplied by using a combination of overhead lines and underground cable. Generally, this transmission should be equipped with an independent cable protection system to detect a fault on the cable thus should not be reclosing the circuit breaker. In this case study, there is no independent cable protection, and there is only one protection for the entire line. The application of the auto-reclose scheme on combined transmission lines needs specific consideration. As short-term mitigation, a distance relay is used with an additional impedance zone setting to discriminate whether a fault occurs in overhead line or underground cable, so it can determine circuit breaker need to reclose or not. To obtain the correct response of distance relay is necessary to apply distance relay setting with measured line impedance data instead of calculated one. Hence, the transmission was shut down to conduct on-site line impedance measurement. The measured data is used as a reference to perform recalculating distance relay setting, then to design and implement an auto-reclose scheme on this transmission line. This implementation is used as an alternative method to provide an auto-reclose scheme on a combined transmission line in the form of overhead line and underground cable, without an independent cable protection system.
An Overview of Reliability and Power Quality of Distribution Network due to Penetration of Rooftop Photovoltaic System and Plug-in Electric Vehicle

Dhandis R. Jintaka, K. G. H. Mangunkusumo, Putu Agus Aditya Pramana
Transmission and Distribution Department PLN Research Institute Jakarta, Indonesia

Abstract: The quality of electricity supply is determined by three main parameters, namely availability (continuity of supply), voltage quality, and speed and accuracy of customer service. This journal will discuss the two main parameters mentioned, which are reliability and power quality. The increased usage of rooftop solar photovoltaic (PV) potentially improves the reliability of the system. With the increasing penetration of renewable distributed generation (DG) in distribution systems, restoration of remote distribution feeder power in an emergency is likely to be carried out with the support of a renewable Solar Power Plant unit. The available power from the renewable DG unit ensures the recovery of the more affected customers, increasing overall system reliability especially the System Average Interruption Frequency Index (SAIFI) and Customer Average Interruption Duration Index (CAIDI). This journal elucidates that the reliability distribution network has the potential to get improved with the power supply from the rooftop PV and vehicle to grid (V2G) mode of the plug-in electric vehicle (PEV). However, the presence of rooftop PV and PEV in the distribution network also harms the voltage regulation, where during the day the voltage tends to fluctuate according to the power supply from the PV rooftop, and at night the voltage tends to decrease along with the charging mode of the PEV. In a distribution network that has two contradictory conditions, this will have an impact on the greater the voltage magnitude gap between day and night which affects the taps of the transformer and the customer’s electronic equipment. This condition should be anticipated using some storage in the distribution network to improve the reliability and power quality.
Evaluation Of High Voltage Live Working MAD Changes Related To Maintenance And Substation Equipment Design In the Case Study of UPT Tanjung Karang
Aryo Tiger Wibowo¹, Kurniawan Danu Diharja², Ferry Fadli³, Abdul Fajar⁴
¹P3B Sumatera PLN Indonesia Pekanbaru, Indonesia ²Divisi PET PLN Indonesia Jakarta, Indonesia ³UPT Tanjung Karang PLN Indonesia Lampung, Indonesia ⁴UPT Pulogadung PLN Indonesia Jakarta, Indonesia

Abstract: Live working minimum approach distance (MAD) value used in the PLN was initially determined from the training results and practical knowledge. To ensure the safety of live working personnel in PLN, the value of MAD determined based on applicable international standards. Due to the determination of this new value, there are changes that should be applied in maintenance activities, and also changes in the design of the distance between the substation equipment. This paper will explain what are the impacts of changes using substation equipment data from one of the substation management units at P3B Sumatra.
Improving Transmission Line Maintenance Strategy by Digitizing Maintenance Report Process and Maintenance Data Visualization
Rizally Priatmadja, Arief Ibrahim Wuller, Rintoko Setyo Wibowo, Ali Rofii, Deni Yanuar Kristiadi, Tejo Wihardiyono
PT. PLN (Persero), Jakarta, Indonesia

Abstract: Along with the disruption affecting the global power market due to economic electrification, renewable energy, new technology, shifting profit pools, and new competition, PT PLN (Persero), a state-owned utility company in Indonesia, is transforming as one of its commitments to become the number #1 electricity company in Southeast Asia. The transformation is carried out through 4 strategies: LEAN, GREEN, INNOVATIVE, CUSTOMER FOCUSED. Through the LEAN strategy, PLN UIT JBT is committed to optimize digital technology to increase the efficiency and reliability of electrical energy transmission. Particularly in transmission line maintenance, a transformation process is being carried out to improve the transmission system’s efficiency, availability, and reliability. This paper will discuss the roadmap for transforming the existing transmission line maintenance strategy by digitizing the entire transmission line maintenance reporting process. It is hoped that real-time anomaly information can be obtained so that the anomaly can execute quickly and effectively.
Investment Assessment using Monte Carlo Method for Power Grid Project in Jawa-Madura-Bali System

Anindita Satria Surya¹, Musa Partahi Marbun², Yehuda Bayu Kristiawan³, Achmad Syerif Habibie⁴
¹Transmission and Distribution Department PT PLN Research Institute Jakarta, Indonesia ²System Planning Division PT PLN Head Office Jakarta, Indonesia ³Planning and Project Control Department PT PLN Pusat Manajemen Proyek Semarang, Indonesia

Abstract: The 35,000 MW project, which the Government of Indonesia declared in 2015, was a massive development of a new power plant installed in the Indonesia power system. Along with this 35,000 MW project, there are 108,000 MVA development of new substations and 46,000 km of new transmissions, which benefit and impact the future of the Indonesian power system. Currently, 35,000 MW projects are rapidly studied and discussed, but there are none in-depth-studies for the relation between 108,000 MVA and 46,000 km of circuit projects with 35,000 MW project itself. This paper discussed several points: the progress projects and their impact on the power system, quantify the economic benefit of each power plant, substation, and transmission project. The Monte Carlo simulation performs to describe the uncertainty conditions from investment cost, capacity factor/loading, generation production cost, and electricity sales tariff. The simulation can produce a range of economic benefit probabilities from each project. The assessment result showed that several projects were postponed, and a few projects there are not financially viable and are very vulnerable to input variable changes.
Network Stress Assessment of Planning Distribution Approach on High Penetrations E-Mobility and DERs
Candra Agus Dwi Wahyudi¹ Fathin Saifur Rahman²
¹Planning Department PT PLN (Persero) Jakarta, Indonesia ²School of Electrical Engineering and Informatics, Institut Teknologi Bandung Bandung, Indonesia

Abstract: Due to the recent trend of energy production and utilization towards a cleaner form of energy, numbers of e-mobility loads and distributed energy resources (DERs) such as rooftop photovoltaic (PV) on distribution networks are increasing. However, e-mobility loads, as well as DERs, have random nature due to their intermittency. In particular, the e-mobility loads have random nature both in terms of charging time and the charging location. Hence in the future, with the increasing number of charging stations, the network overload may occur subject to the additional e-mobility loads. Furthermore, the connection of PV and e-mobility loads will affect the voltage of the distribution system (i.e., will increase and decrease the voltage, respectively). Hence, their effects on the power equipment should be considered. In this paper, the network stress test method based on the stochastic distribution approach is performed to assess the impact of e-mobility loads or DER on the voltage and loading factors in the distribution network while also assessing the number and capacity of charging facilities. The number of e-cars and the available load connection points is defined. The obtained results are then analyzed based on the voltage and network capacity constraints of the network. Finally, the required network upgrades and the planning decision of the distribution networks are proposed based on the resulting network capacity condition.
Power Quality Analysis of Solar PV/Micro-Hydro/Wind Renewable Energy Systems for Isolated Area
Dwi Sahidin, Tri Desmana Rachmildha, Deny Hamdani
School of Electrical Engineering and Informatics Institut Teknologi Bandung Bandung, Indonesia.

Abstract: Renewable energy systems are technologically matured and promising to replace conventional fossil fuel energy systems that produce greenhouse gas emissions. However, renewable energy generation also encounters problems such as power quality issues. The intermittency nature of renewable energy resources, such as varying irradiance of solar PV and wind speed of wind energy in an isolated area, has potentially led to voltage fluctuations on the source side and generate harmonic distortion due to the inverter switching process. The main objective of this paper is to analyze the power quality issues of a standalone solar photovoltaic/micro-hydro/wind energy system. This study adopts an off-grid solar photovoltaic/micro-hydro system in Teluk Sumbang, East Borneo, Indonesia, as a case study to construct a renewable energy system. For this purpose, voltage fluctuations may vary about ±10% of its nominal value according to IEC standards. Total harmonic distortion (THD) indices according to IEEE standard 519-2014 are used. The simulation model is developed and observed using MATLAB/Simulink environment. A three-phase inverter with closed-loop voltage control insulated gate bipolar transistor inverter is applied to convert DC to AC and supply power to AC loads. LC and LCL filters use to minimize the harmonics distortion injected by the inverter switching process. Results show that under intermittency nature of renewable energy sources leads to power quality issues concerning voltage fluctuation. THD of voltage and current of the systems are less than 5%, and it is still within an acceptable range in IEEE standard limitation.
An Overview of Reliability and Power Quality of Distribution Network due to Penetration of Rooftop Photovoltaic System and Plug-in Electric Vehicle

Dhandis R. Jintaka, K. G. H. Mangunkusumo, Putu Agus Aditya Pramana
Transmission and Distribution Department PLN Research Institute Jakarta, Indonesia

Abstract: The quality of electricity supply is determined by three main parameters, namely availability (continuity of supply), voltage quality, and speed and accuracy of customer service. This journal will discuss the two main parameters mentioned, which are reliability and power quality. The increased usage of rooftop solar photovoltaic (PV) potentially improves the reliability of the system. With the increasing penetration of renewable distributed generation (DG) in distribution systems, restoration of remote distribution feeder power in an emergency is likely to be carried out with the support of a renewable Solar Power Plant unit. The available power from the renewable DG unit ensures the recovery of the more affected customers, increasing overall system reliability especially the System Average Interruption Frequency Index (SAIFI) and Customer Average Interruption Duration Index (CAIDI). This journal elucidates that the reliability distribution network has the potential to get improved with the power supply from the rooftop PV and vehicle to grid (V2G) mode of the plug-in electric vehicle (PEV). However, the presence of rooftop PV and PEV in the distribution network also harms the voltage regulation, where during the day the voltage tends to fluctuate according to the power supply from the PV rooftop, and at night the voltage tends to decrease along with the charging mode of the PEV. In a distribution network that has two contradictory conditions, this will have an impact on the greater the voltage magnitude gap between day and night which affects the taps of the transformer and the customer's electronic equipment. This condition should be anticipated using some storage in the distribution network to improve the reliability and power quality.
A Voltage Rise Mitigation Control Scheme of Utility-Scale Battery in High PV Penetration
Wijaya Yudha Atmaja, Sarjiya, Lesnanto Multa Putranto
Department of Electrical and Information Engineering, Universitas Gadjah Mada, Yogyakarta, Indonesia

Abstract: In the distribution grids with high R/X proportion, active power curtailment (APC) of battery energy storage system (BESS) becomes an effective strategy for mitigating voltage rise, which is caused by high photovoltaic (PV) penetration. To this purpose, previous researches have presented studies of utility-scale BESS implementation for utility-scale PV penetration. However, the requests for customer-scale PV integration into distribution grids are rapidly increasing. This condition leads to the requirements for studying the performance of utility-scale BESS for the customer-scale PV penetration. Therefore, this article proposes a voltage rise mitigation control scheme of utility-scale BESS for high penetration of customer-scale PV systems. Since the previous studies provided the BESS implementation for utility-scale PV penetration, implementing the BESS control scheme on the distribution system with high customer-scale PV penetration is necessary. It is because, in the last few years, the PV penetration is increasing massively. Moreover, to perform an appropriate BESS control, a control scheme based on the maximum voltage is proposed in this research. To justify the proposed method, the IEEE 123-node test feeder is employed. The results indicate that the proposed control scheme can be used by the distribution system operator in utilizing the utility-scale BESS for voltage rise mitigation in the system with high penetration of customer-scale PV systems. Specifically, this article provides the foundation for performing future studies.
Study of Power Quality Problems for Improving The Quality of Electricity in Java: Case Study of East Java Regional Industry Customers with Power Greater Than 30 MVA
A. S. Habibie, M. Ridwan, D. R. Jintaka
Ristek TND PLN Research Institute Jakarta, Indonesia

Abstract: The reduction of electricity growth, especially in Java, has prompted PLN to improve its electricity sales business process toward power quality improvement by providing additional services to industrial customers. Improving the quality of the electric power supply will increase customer engagement and electricity consumption, especially for industrial segment (I-Class). This study used the recorded data from Power Quality Meter (PQM) in the Java Bali System to evaluate the power quality supplied by PLN based on the type of industrial cluster and customer location. The Information Technology Industry Council (ITIC) standard curve was used as a reference for evaluating PQM data. According to the year 2020 recorded data plot to the ITIC curve from 22 sample industry customer in East Java, it was found that 193 from the total of 1550 incidents were classified as failed condition. About 116 of them were classified as under or over voltage and interruption (long duration class), while the rest were classified as transient, sag, and swell (short duration class). Power quality problem for short duration class based on industrial type and location were dominated by instantaneous sag.
Backward Forward Sweep Algorithm for Unbalanced Three-Phase Power Flow Analysis in Distribution Systems Containing Voltage Regulator

Taqiyuddin, Suwarno, Gibson H. M. Sianipar, Muhammad Nurdin
School of Electrical Engineering and Informatics, Institute of Technology Bandung, Bandung, Indonesia

Abstract: The distribution system has its own characteristics such as a high R/X ratio; has a radial or weakly meshed topology; or multiphase system. Various studies have been carried out with different approaches to solving power flow in distribution systems to produce a robust and simple method, but the backward forward sweep (BFS) method remains the main choice mainly because of its simplicity. This study aims to validate the accuracy of the power flow algorithm in a distribution system containing a voltage regulator based on the BFS method. The process of compiling the algorithm is divided into 2 stages, namely the initial stage without involving a voltage regulator, and the next stage, the voltage regulator being involved in the power flow process. Furthermore, each step or stage of the power flow will produce a power flow output and the results will also be individually validated. The simulation results applied to the IEEE 37 node test system as a benchmark in conditions without a regulator, namely in phases AB, BC, and CA have a smaller maximum voltage magnitude difference of 30%, 40%, and 60% respectively when compared to the results of the other study, so that better results are obtained. Meanwhile, when the voltage regulator is involved in the power flow, the simulation results obtained in phases AB, BC, and CA have a maximum voltage magnitude difference with 1E-04, 1E-04, and 2E-04 respectively. This difference is so small that it gives confidence that the algorithm that has been compiled has high accuracy.
Performance Analysis of Offshore Floating PV Systems in Isolated Area
Radhiansyah, Tri Desmana Rachmilda, Deny Hamdani
School of Electrical Engineering and Informatics, Institut Teknologi Bandung, Bandung, Indonesia

Abstract: The PV solar system is one of the most popular renewable energy systems. Besides being easy to apply, the infrastructure is usually more flexible than other power plants and the resources can be found almost anywhere. Along with the increasingly frequent use of PV power plants in isolated areas, there are obstacles to land use, especially in island areas, where land has been used for housing and community activity areas, so that there is no location left for PV power plants placement. Therefore, the PV power plant is installed above the water surface, known as offshore floating PV. Offshore floating PV and conventional land PV have different ecosystems, so there will be differences in performance. The performance of the power system is one aspect of choosing which system is best to apply. In this research, the indicators of the performance of the power system are voltage, current, and power output. They will be compared between offshore floating PV and conventional PV on land. The research location is the Kudingarenglompo island, which is an island located off the coast of Makassar, South Sulawesi, Indonesia. 400kW is provided as system capacity, which is based on the existing power system on the island. The research results show that current and voltage on offshore floating PV are higher than conventional PV on land, so the power output from offshore floating PV is higher than on land PV. The average power output on land PV is 1.29% lower than on offshore floating PV.
LIST OF AUTHOR

A
A. Abu-Siada Plenary Session 3-1
A. H. M. Nasib 87
A. P. Purnomoadi Plenary Session 2-3
A. S. Surya 14, 15, 25
Aan Nur Arifin 125
Abdu Yakan Rosyadi 63
Abdul Fajar 18
Abdul Muiz 16
Achmad Syerif Habibie 17, 25, 130
Adelina Utari 10
Adib Akbar Jaelani 21, 27
Adjie Bagaskara 39
Adri Senen 120, 122
Afrias Sarotama 109
Agus Purwadi 63
Agus Suhendra 109
Agus Trimanto 115
Agustriadi 115
Ahadiyat 110
Ahlem Ben Halima 162
Aji Suryo Alam 42, 43
Akhilesh Kumar Pandey 108
Ali Ahmed Salem 144
Ali Muhtar 152
Ali Rofii 5
Amdi Nopriansyah 117
Andre Widura 22
Andrea Cavallini Plenary Session 3-2
Anindita Satria Surya 17
Antonius Darma Setiawan 107
Antonius Paddeda 35
Apoorva Sahu 127
Arfan Idha Norgiyanto 100
Ariadi Hazmi 23
Arief Ibrahim Wuller 5
Arien Hanadya 50
Arpen Zaei 133, 160
Arwindra Rizkiawan 31, 59
Aryo Tiger Wibowo 18
Asih Kurniasari 82
Azhan Ab Rahman 144

B
Bagas Maulana Sutardi 51, 50
Bambang Anggoro Soedjarno P. 26, 105
Bhaba Das 29
Bo Hu 114
Bryan Denov 4, 77, 141, 146
Bülent Oral 118
Burhanuddin Halimi 31, 62, 133
Byron Cabrera R 121

C
Candra Agus Dwi Wahyudi 157
Candra Febri Nugraha 65
CH A Andre Mailoa 136
Chairul Bahy 55
Chairul G Irianto 70
Christine Widyastuti 120
Credo Malouna Saragih 143

D
Dahlang Tahir 126, 151, 155
Daniar Fahmi 55
Dede Rilwan Alwaini 129
Delvin Anugerah 22
Deni Yanuar Kristiadi 5
Deny Hamdani 53, 58, 60
Devni Syafrianto 165, 171
Dewi Kusuma Wardani 64
Dhandis R. Jintaka 14, 15, 25, 46, 71, 130
Dharma Saputra 74
Dian Yayan Sukma 120
Dianing Novita Nurmala Putri 70
Dieu Vo Ngoc 76
Dimas Aji Nugraha 40, 43
Dimas Anton Asfani 47, 55
Dinuka Dilshan 123
Dionysius A. Renata 82, 109
Dispriansyah 115
Diya Li 145
Dwi Anggainsi 122
Dwi Sahidin 58
Dzikri Firmansyah Hakam 171
E 
Eddie Widiono Suwondo 70 
Eduard Mulyadi Plenary Session 1-1, 13, 76 
Edwin Nugraha Putra 65 
Eka R. Priandana 109 
Eko Agus Murjito 166 
Erny Anugrahany 40, 81

F 
Fabianus Marintis Dwijayatno 110 
Faiq Arkan Dewanto 74 
Fakroul Redzuan Bin Hashim 142 
Fan Qirui 106 
Farhan Hafiz Budistrianto 4, 77 
Farradita Nugraha 161 
Fathin Saifur Rahman 157, 164, 166, 168 
Fauzi Handy Dewanto 62 
Fauzia Haz 137 
Febrian Hadiatna 22 
Ferry Fadli 18 
Flavio Quizhpi-Palomeque 121 
Francisco Gómez-Juca 121

G 
Geby Chintia 32 
Georges Zissis 162 
Gibson H. M. Sianipar 41 
Gilbert Teyssedre Plenary Session 3-3 
Ginas Alvianingsih 124 
Giri Angga Setia 134, 136, 137 
Goro Fujita 56, 92, 145 
Guan-Jun Zhang Plenary Session 1-4 
Guntur Supriyadi 40, 42, 43

H 
H. C. Xiang 85 
H. B. Tambunan 14, 15 
Hadi Jameel Hadi 111 
Hafisoh Abdul Ahmad 144 
Hafsah Halidah 82 
Hakim Habibi 42, 81 
Hakim Habibie HU 43 
Hanan j. Abdulkareem 111 
Handoko Rusiana Iskandar 134, 136, 137 
Hardiansyah Rahmat Nurhakim 44, 72 
Hariadi Aji 12 
Harry Gumilang 37 
Hasan Adil 118 
Hasna Satya Dini 122, 128, 129 
He Mingpeng 106 
Henny Ika 16 
Herry Sutikno 97, 105 
Herry Nugaraha 171 
Hikmah Prasetia 117 
Hu Bo 106 
Hugo Hadi Suhana 61

I 
I Gusti Ngurah Mahendrayana 100 
I Gusti Ngurah Satriyadi Hernanda 55 
I Made Yulistya Negara 47, 55 
Ignatius Rendroyoko 35, 61, 107 
Ikhlas Kitta 80 
Ikhwan Wiranata 59 
Ilham Muliawan Hamzah 146 
Ilhamid Daris 44, 72 
Imam Makhfud 100 
Irving Paul Girsang 76 
Iskandar Nungtjik 35 
Iwa Garniwa 124

J 
Ja’afar Bin Adnan 142 
Jarot Setyawan 125 
Jean Pierre Uwiringiyimana 103 
Jenan Ayad 111 
Jihad Furqani 59 
Jingjing Lu 98 
Jinuo Kim 13 
Jitendra Kumar Singh 108 
John Morales 121 
Joko Hartono 43, 81
K
K G H Mangunkusumo 14, 15, 25, 46, 71
Kamel Charrada 162
Kevin M. Banjar Nahor 33, 166, 164, 165, 168, 169, 170, 171
Khotimatul Fauziah 82, 109
Koji Urano 98
Komaruddin 33
Kukuh Pambudi 74
Kurniawan Danu Diharja 18

Laurent Canale 162
Le Xuan Chau 113
Lei Xiong 92
Lesnanto Multa Putranto 65, 67
Liu Xuezhong 106
Lunnetta Safura Lumba 21, 27, 30

M
M Nugratama Sudarsanto 125
M Reza Hidayat 137
M. A. B. Sidik 34
M. A. M. Piah 87
M. H. Ahmad 34, 85, 86, 87
M. I. Jambak 34
M. Muslih Mafruddin 40
M. Ridwan 25, 81, 130
M. Rivandi Fadli 164
Marwan Marwan 126, 151, 155
Masayuki Hikita Plenary Session 1-3
Mateo Quizhpi-Cuesta 121
Maula Sukma Widjaya 70
Mawla Ahmad 44, 72
Mayur Basu 13
Mehmet Murat Ispirli 118
Mehmet Zeki Celik 118
Min Chen 98
Minh Quan Duong 113
Mirza Farhan 16
Mohammad Wahyudi 74
Mohd Taufiq Bin Ishak 142
Mohd. Shahnawaz Khan 108
Muhammad A. Tayyab 45
Muhammad Mushthofa Musyasy 170
Muhammad Muslih Mafruddin 81
Muhammad Nuridin 41
Muhammad R. Fabio 24
Muhammad Ridhwan 30, 63
Muhammad Rizky Alfarizi 134
Muhammad Rully 16
Musa Partah Marbun 17
Mustarom Musaruddin 80
MV Reddy Plenary Session 2-1

N
N. A. Awang 86
N. M. Saman 34, 85, 86, 87
N. Pattanadech Plenary Session 2-4
Na Chai 84
Naftalin Winanti 134, 136, 137
Nana Heryana 134
Nanang Hariyanto Plenary Session 3-4, 33, 164, 165, 166, 168, 169, 170, 171
Naoki Satryo Anggito 55
Naufal Hilmi Fauzan 159
Nelson Silaen 110
Nivika Tiffany Somantri 136
Noor Akhmad Setiawan 74
Nor Akmal Mohd Jamail 144
Novizon 83
Nuel Yosia 169
Nur Ulfa Maulidevi 105
Nurfi Syahri 83
Nuriyanto Eko Saputro 32
Nurul Izzati Binti Hashim 142

O
Oksa Prasetyawan 40, 42
Oktaria Handayani 120
Özcan Kalenderli 118
P
Pekik Argo Dahono  
Plenary Session 1-2, 59
Ping Liu 114
Pinto Anugrah 64
Pradita Octaviandiningrum Hadi 26, 171
Prasetyo 16
Purwono Prasetyawan 152
Pushpendra Singh 108
Putranusa Perkasa 125
Putu Agus Aditya Pramana 46, 71

Q
Qirui Fan 114

R
R. Sarathi Plenary Session 3-5
Ra Crystal S. P. Tambun 168
Radhiansyah 60
Rahisham Abd Rahman 142, 144
Rahman Azis Prasojo 28, 32, 97, 105
Rakesh Sahoo 127
Rasara Samarasinghe 123
Reynaldo Zoro 4, 77, 141
Reza Sarwo Widagdo 47
Ridho Arisyadi 53
Rijal Ridwanullloh 134
Rintoko Setyo Wibowo 5
Rizky Prananda 128
Riza 82, 109
Rizally Priatmadja 5, 28
Rizki Firmansyah Setya Budi 65
Rizky Rahmani 164, 166, 168
Rizwan Ahmad 144
Robert M. Nelms 13
Rofiul Huda 28
Rohan Lucas 123
Rudy Gianto 9
Rudy Setyobudi 35
Rushdan Bin Ibrahim 142
Ruwansi Kaldasani 123

S
S. Jaruman 85
Sabhan Kanata 152
Salama Manjang 80
Sandro Sitompul 56, 145
Sarjiya 65, 67
Sasindu Thennakoon 123
Septiyan 16
Shafa Nabila Haya 21, 27
Shaobo Huang 114
Shuqi Zhang 84
Silvia Wulandari 83
Sriyono 25
Subrata Karmakar 127
Sufianto 16
Suhardi 107
Suwarno Plenary Session 2-5,
  4, 21, 27, 30, 32, 33, 39, 41, 44, 72,
  77, 97, 103, 105, 133, 141, 28
Syadila Refiasto 77, 141
Syafaruddin 80
Syafii 64
Syahirulputra 16
Syahril A. Ginanjar 31
Syamsir Abduh 70, 143
Syamsyarief Baqaruzi 152
Syarif Hidayat 4, 24, 77, 146

T
Takashi Minemura 92
Tambi 80
Taqiyuddin 41
Tejo Wihardiyono 5
Tessamonica Luthfia 110
Thanh Le Van 113
Thao Huynh Van 113
Thoa Le Thanh 76
Toto Winata 152
Tri Desmana Rachmilda 53, 58, 60
Tri Harianto 126, 151, 155
Tri Wahyu Oktaviana Putra 128
Tumiran Plenary Session 1-5, 65, 74
Tuyet Mai Nguyen Thi 113
Tyas Kartika Sari 70

U
Udaya K. Madawala Plenary Session 2-2
Umar Khayam 24, 103, 133, 159, 160, 161

V
Vendy Antono 124
Victor Humala A 121

W
Waluyo 22
Wijaya Yudha Atmaja 67
Winarno 100
Wisnu Adyatma S. 4

X
Xuezhong Liu 114

Y
Yehuda Bayu Kristiawan 17
Yenni Tarid 125
Yingying Liu 98
Yanting Xie 98
Yonny Wicaksono 125
Yuan Pengfei 106
Yudha Nugroho 117
Yuki Hayashi 56
Yuli Astriani 82, 109
Yvon Besanger 61

Z
Z. Adzis 34, 85, 86, 87
Z. Buntat 34, 85, 86, 87
Z. Nawawi 34
Zaid Khudhur Hussein 111
Zaini 10
Zainur Oktavian Prabandaru 100
Zakka Izzatur Rahman Noor 26
Zhang Yue 106
Zhengyu Xu 84
Zhiming Liang 114
Zhipeeng Zhou 98
Ziega Zetu Zaen 137
Zilfa Hasanita Natalia 125
Zouhour Araoud 162
Zuoxian Wang 84