

2023 12th Asia-Pacific International Conference on Lightning (APL 2023)

**Langkawi, Malaysia
12-15 June 2023**



**IEEE Catalog Number: CFP2396P-POD
ISBN: 978-1-6654-5686-9**

**Copyright © 2023 by the Institute of Electrical and Electronics Engineers, Inc.
All Rights Reserved**

Copyright and Reprint Permissions: Abstracting is permitted with credit to the source. Libraries are permitted to photocopy beyond the limit of U.S. copyright law for private use of patrons those articles in this volume that carry a code at the bottom of the first page, provided the per-copy fee indicated in the code is paid through Copyright Clearance Center, 222 Rosewood Drive, Danvers, MA 01923.

For other copying, reprint or republication permission, write to IEEE Copyrights Manager, IEEE Service Center, 445 Hoes Lane, Piscataway, NJ 08854. All rights reserved.

****** This is a print representation of what appears in the IEEE Digital Library. Some format issues inherent in the e-media version may also appear in this print version.***

IEEE Catalog Number:	CFP2396P-POD
ISBN (Print-On-Demand):	978-1-6654-5686-9
ISBN (Online):	978-1-6654-5685-2

Additional Copies of This Publication Are Available From:

Curran Associates, Inc
57 Morehouse Lane
Red Hook, NY 12571 USA
Phone: (845) 758-0400
Fax: (845) 758-2633
E-mail: curran@proceedings.com
Web: www.proceedings.com

CURRAN ASSOCIATES INC.
proceedings
.com

TABLE OF CONTENTS

Overvoltage Caused by Switching Operation - A Threat to SPDs..... <i>Ralph Brocke, Christian Höhler</i>	1
Indirect Lightning Surge Analysis of Insulated Rail Bracket and Station Arrester in a Fourth Rail LRT System <i>Farah Asyikin Abd Rahman, Ungku Anisa Ungku Amirulddin, Mohd Zainal Abidin Ab Kadir, Miszaina Osman</i>	6
Coordinated SPD Systems for Mitigating the Effect of Lightning-Induced Voltage on Hybrid Solar PV-Battery Energy Storage System <i>N. I. Ahmad, M. Z. A. Ab. Kadir, Z. Ali, M. Osman, M. H. Roslan, N. H. Zaini</i>	12
Top-Oil Thermal Model for Power Transformers that Reflects Ambient Temperature Profile in Malaysia <i>Siti Nur Aishah Binti Azman, N. H. Nik Ali, Atip Doolgindachbaporn, A. Mohd Ariffin, N. Azis, N. Aminudin</i>	17
Performance of Bentonite and Zeolite Mixtures as Grounding Enhancement Materials <i>W. F. H. Wan Ahmad, N. Marudin, J. Jasni, M. Z. A. Ab-Kadir</i>	23
Performance of Bentonite and Peat Moss Mixtures as Grounding Enhancement Materials <i>W. F. H. Wan Ahmad, A. H. Abdul Rahman, J. Jasni, M. Z. A. Ab-Kadir</i>	28
Analysis of the Electromagnetic Field (EMF) Distribution on the Human Body Due to Earth's Potential Rise (EPR) of Different Types of Soil..... <i>Siti Nurhidayu Binti Bani Hashim, N. H. Nik Ali, M. S. Abd Rahman, D. Johari, Faranadia Abdul Haris, M. Z. A. Ab Kadir</i>	34
Some Observations Pertaining to the Adequacy of Lightning Current Injection Tests to Aircraft <i>Surekha Jonnalagadda, Udaya Kumar</i>	40
On the Striking Distance for the Design of Lightning Protection System for Substations in Selected Countries <i>Siow Chun Lim, Md Mahmudul Hasan, Ong Chang Shen</i>	45
Advanced Performance Testing of a Lightning Current Arrester Based on Spark-Gap Technology..... <i>Gernot Finis, Thomas Meyer, Hannes Sagebiel</i>	51
Surge Protection with SPDs and SITs..... <i>Yasuharu Yamada</i>	57
Characteristics of Ground Wire Currents Along Transmission Line Under Lightning Strikes..... <i>Zherui Cui, Yao Yao, Zijian Li, Wei Shen, Bo Zhang, Jinliang He</i>	61
Positive Pre-Breakdown Streamer Propagation and Breakdown Voltage of Palm Oil Based Al ₂ O ₃ <i>Yee Von Thien, Norhafiz Azis, Nur Aqilah Mohamad, Xiao Jian Tan, Zaini Yaakub</i>	66
Ground Strike Point Properties Derived from Observations of the European Lightning Location System EUCLID..... <i>Dieter Roel Poelman, Hannes Kohlmann, Wolfgang Schulz, Stephane Pedeboy, Lukas Schwalt</i>	70

Japanese Industrial Standards Requirements and Performance Evaluation of Lightning Detector for Wind Turbine.....	75
<i>Yoshito Abe, Koji Inazaki, Kazuma Shinomura</i>	
Preliminary Results of Corona Discharge Current Measurements in the Early Formation of Lightning on Tower	80
<i>Shaoyang Wang, Mingli Chen, Yan Gao, Ya-Ping Du</i>	
Estimation of the Average Annual Number of Lightning Flashes to a Group of Wind Turbines in France.....	84
<i>Stéphane Pédeboy</i>	
Study of Lightning Detection Method Using Acoustic Data	89
<i>Yutaro Higashi, Kazuo Yamamoto</i>	
Characteristics of Lightning Discharges to Wind Turbines and Weather Conditions at Upper Air in Winter in Japan.....	94
<i>Michihiro Matsui, Nobuyuki Honjo, Koji Michishita, Shigeru Yokoyama</i>	
Efficiency of the Earthing System in a Large-Scale Solar Power Plant During Lightning	100
<i>Eduard Shulzhenko, Ralph Brocke, Martin Hannig, Julienne Puttkammer</i>	
Transient Overvoltage Response of Photovoltaic Panels to Lightning Impulse: Experimental Observations and Analysis	106
<i>Ibrahim Hetita, Amr S. Zalhaf, Diaa-Eldin A. Mansour, Yang Han, Ping Yang, Congling Wang</i>	
Analysis of Lightning Activities in Wind Farm Based on Lightning Location Data and Voronoi Diagram.....	112
<i>Yu Wang, Ze Liu, Fengquan Li, Zhe Li, Jian Li, Shanqiang Gu</i>	
Estimation of Stray Parameters in Lightning Impulse Voltage Generation Circuit	116
<i>Pongsatorn Termtachatipongsa, Peerawut Yutthagowith</i>	
Study on Cable Coupling Effects of Lightning Strikes on a Metal Mast.....	121
<i>Fan Haoshen, Zhou Mi, Zheng Shengquan, Wang Dongdong, Zuo Xinrui, Cai Li, Wang Jianguo</i>	
A Simplified Method for Probability-Based Assessment of Flashover Occurred on the Medium-Voltage Distribution Network Due to Lightning	127
<i>Jinxin Cao, Yaping Du, Jianguo Wang, Li Cai, Yuxuan Ding, Mi Zhou, Amedeo Andreotti, Yadong Fan</i>	
Research on Effect of Shield Wire for 10 kV Distribution Lines Via Triggered Lightning.....	133
<i>Li Cai, Changfeng Xu, Jinxin Cao, Mi Zhou, Yadong Fan, Jianguo Wang</i>	
Return-Stroke Field Close to the Channel with Finitely Conducting Earth.....	139
<i>Rupam Pal, Udaya Kumar</i>	
Risk Assessment of Surge Arresters for Efficient Maintenance of Medium-Voltage Distribution Lines.....	145
<i>Masahiro Ueda, Shinji Yasui, Hidekazu Tanaka, Tomoaki Nonoyama, Yasuyuki Kunii</i>	
Simulation Analysis of Lightning Resistance Level Under Different Installation Modes of Lightning Protection Measures.....	150
<i>Yao Yao, Zijian Li, Jianjin Fu, Xiankang Wang, Zhiqiang Feng, Xueming Zhou</i>	

Characteristics of Damages of Distribution Lines Due to Lightning in Hokuriku Area of Japan	156
<i>Susumu Matsuura, Kenichi Kanatani</i>	
Simulation Analysis of the Influence of Multiple Factors on Lightning Shielding Characteristics Between Dense Transmission Lines	160
<i>Zijian Li, Yao Yao, Zhiqiang Feng, Ye qiang Deng, Haochen Zhang, Yu Wang</i>	
Impact of Lightning on Tower Footing Design of 500 kV Transmission Line.....	165
<i>N. A. F. Mohd Nasir, M. S. Mohd Nasir, Muhamad Safwan Abd Rahman, M. Z. A. Ab-Kadir, N. Azis, M. Osman, Ungku Anisa Ungku Amirulddin</i>	
Development of Controllable Metal Oxide Surge Arrester with Trigger Switch for 500kV AC Power System.....	171
<i>Wei Cao, Shanqiang Gu, Jian Li, Shuai Wan, Xiumin Chen, Zihao Liu</i>	
Partial Discharge Localization of Refined Bleached Deodorized Palm Oil (RBDPO) Based on Acoustic Emission Method.....	176
<i>Nur Darina Ahmad, Ahmad Hafiz Mohd Hashim, Norhafiz Azis, Mohd Aizam Talib, Khairil Anas Md Rezali, N. H. Nik Ali, Jasronita Jasni, Kozako Masahiro, Mohamad Kamarol Mohd Jamil</i>	
Examination on Acoustic Emission Partial Discharge Localization Error Rate in Oil in the Presence of Pressboard	181
<i>Ahmad Hafiz Mohd Hashim, Nur Darina Ahmad, Norhafiz Azis, Jasronita Jasni, Mohd Amran Mohd Radzi, Masahiro Kozako, Mohamad Kamarol Mohd Jamil</i>	
A Year of Global Lightning Deaths and Injuries	185
<i>Ronald L. Holle</i>	
Lightning Accidents in Zambia	191
<i>F. C. Lubasi, C. Gomes</i>	
Characteristics of Bolt-From-the-blue Lightning Discharge Produced by a Thunderstorm in Japan on August 26, 2018.....	197
<i>Takeshi Kudo, Namiko Sakurai</i>	
Location of the Space Stem in Long Negative Laboratory Sparks.....	203
<i>Xiangen Zhao, Yaping Du, Lili Guo, Yang Liu, Junjia He</i>	
Observation of Lightning Discharge Current in Kyushu in Japan.....	207
<i>Koji Michishita, Koji Takano, Takao Kawazoe, Masateru Ikuta, Shigeru Yokoyama</i>	
Correlation Analysis of Lightning and Flash Flood Events Using Pearson Model in Southeast Peninsular Malaysia.....	212
<i>N. Bahari, M. R. M. Esa, M. A. Wahab</i>	
A Strong Positive CG Flash that Was Simultaneously Recorded by Multiple Observation Systems	218
<i>Junchen Yang, Daohong Wang, Haitao Huang, Ting Wu, Nobuyuki Takagi, Kazuo Yamamoto</i>	
EMTP Simulation Model for Mutual Grounding Resistance Considering Propagation Time.....	222
<i>Shozo Sekioka</i>	
A Study on the Detection of Lightning Strikes on Wind Turbines with a Camera System.....	228
<i>Fuma Mori, Kazuo Yamamoto</i>	

Development and Initial Performance Assessment of the ULAT VLF Lightning Detection System in the Philippines	232
<i>Pocholo Miguel A. De Lara, Jerico M. Orejudos, Jeffery A. Aborot, Glenn Vincent C. Lopez</i>	
GIS-Based Development and Visualization of Ground Flash Density Maps During the Monsoon Seasons in Peninsular Malaysia.....	238
<i>N. Roslan, M. Z. A. Ab-Kadir, U. A. Ungku Amirulddin, H. Z. Mohd Shafri, N. Abdullah</i>	
Real-Time Lightning 3D Imaging and Forecasting Project in Malaysia for Sustainable and Reliable Supply of Energy and Storm Disaster Early Warning	244
<i>Takeshi Morimoto, Mohd Riduan Ahmad, Mohd Zafri Baharuddin, Daohong Wang, Kazuo Yamamoto, Takeshi Kudo, Ammar Nasser Al Kahtani, Mohamad Zoinol Abidin Abd Aziz, Manabu Akita, Yuji Takayanagi, Zen-Ichiro Kawasaki, Tatsuo Torii</i>	
Performance Evaluations of Lightning Detection System for Wind Turbine	248
<i>Kei Miyamoto, Kazuki Oobayashi, Junichi Suzuki, Kazuo Yamamoto, Hiroshi Kogo, Tomoya Tsuchida</i>	
Statistical Cloud-To-Ground Lightning Data and Its Implementation for 33kV Overhead Line in Peninsular Malaysia.....	253
<i>Norhasliza Mohd Hatta, Noradlina Abdullah, Miszaina Osman, Azwadi Mohamad</i>	
Comparison of Thunderstorm Characteristics Between Changdu and Wuhan in China Based on Spatio-Temporal Clustering of LLS Data.....	257
<i>Ze Liu, Yu Wang, Lei Zhang, Fengquan Li, Dawei Wu, Bingjie Bai</i>	
Characterization of Lightning in the Lhasa Region of Tibet	263
<i>Ting Lei, Weidong Shi, Yang Zhang, Xia Zhao, Zixin Guo</i>	
A User's Experience: Automated Fault Analysis System in Identifying Lightning Outages on Transmission Lines.....	269
<i>M. I Shamsudin, N. S Hudi, Y. W Chung</i>	
Lightning and Overhead Line Fault Analysis Using Automated Fault Analysis Application on Transmission Line in Grid Division, TNB Malaysia.....	273
<i>Chung Yoke Wai, Nadiah Salwi Hudi, Muhammad Shahmi Bin Muhamad Shokri, Ir. Noradlina Abdullah</i>	
Lightning Risk Assessment for the Typical 10 kV Distribution Line.....	277
<i>Yao Yao, Zijian Li, Zejun Lu, Jian Li, Xueming Zhou, Yingpu Xie</i>	
Lightning Sensitivity Assessment Based on Topographic Factors	282
<i>Baoyu Xu, Xiao He, Jiajun Cao, Yejiang Deng, Shuangde Huang, Yu Wang</i>	
Analysis of Distribution Characteristics of Cloud-To-ground Lightning at Different Spatiotemporal Scales.....	287
<i>Shanqiang Gu, Fengquan Li, Pei Wang, Jian Li, Zhe Li, Hantao Tao</i>	
Effects of Aerosols on Lightning Activity Over the Himalayan Region	293
<i>Pradip Karki, Shriram Sharma, Khem Narayan Poudyal, Madhu Gyawali, Sujana Neupane</i>	
The Characteristic of Negative Cloud-To-ground Lightning with Multiple Return Strokes	299
<i>Yun Pan, Dong Zheng, Yijun Zhang</i>	
Characteristics of Winter Lightning Frequency in Wakasa Bay, Japan	303
<i>Tomonobu Shibuya, Fukumune Suzuki, Yuichi Takahashi, Yasushi Watarai</i>	

Relationship Between Laboratory Simulated Multicomponent Waveforms of the Lightning Current Pulse and Discharge Channel Light Intensity	307
<i>Xinrui Zuo, Zhou Mi, Wang Dongdong, Zhao Weihai, Cai Li, Wang Jiangguo</i>	
Simulation Test of Positive Corona Discharge at Blade Tip of Rotating Wind Turbine	313
<i>Qiang Wu, Yu Wang, Yejiang Deng, Xiaoyue Chen, Lei Lan, Xishan Wen</i>	
Cloud-To-Ground Lightning Activity Over Land and Ocean in Peninsular Malaysia	317
<i>M. S. Azaman, D. Johari, F. Abdul Haris, A. F. Abidin, N. H. Nik Ali, N. Mohd Hatta</i>	
Lightning Behaviour in Beaufort, Sabah	322
<i>M. Y. Jaafar, M. F. Awang, I. Musirin, M. A. R. Parsat, D. Johari, R. Lim, A. K. Majeed</i>	
Temporal and Spatial Distribution Characteristics of Lightning in the Yangtze River Delta of China from 2011 to 2019	327
<i>Xiangyang Cheng, Kai Wang, Xiaoyu Ju</i>	
Observation of the Space Leader During the Attachment Process in Positive Laboratory Sparks	331
<i>Xiankang Wang, Xiaopeng Liu, Zijian Li, Yao Yao, Junjia He</i>	
Attachment Process of a Downward Negative Flash with Multiple Return Strokes Struck to a 356-M-Tall Tower in Southern China	335
<i>Yan Gao, Mingli Chen, Shaoyang Wang, Zilong Qin, Zongxu Qiu, Ge Zhang, Ran Cai, Jun Zhang, Yaping Du</i>	
Surge Arrester Monitoring Implementation at 33kV Distribution Overhead Line in Malaysia.....	340
<i>Noradlina Abdullah, Mohd Faris Ariffin, Norhasliza Mohd Hatta, Muhammad Fazli Nozlan, Azwadi Mohamad, Miszaina Osman</i>	
Lightning Fault Classification for Transmission Line Using Support Vector Machine	343
<i>Saidatul Habsah Asman, Nur Fadilah Ab Aziz, Mohd Zainal Abidin Ab Kadir, Ungku Anisa Ungku Amirulddin, Nurzanariah Roslan, Ahmed Elsanabary</i>	
Development and Application of the ± 1100 kV UHV DC Transmission Line Arrester	349
<i>Shanqiang Gu, Shuai Wan, Zihao Liu, Jian Li, Min Wu, Wei Cao</i>	
A Study of Power Outage Reduction Due to Lightning by Using the Different Dielectric Strength of Supporting Points of Distribution Lines	354
<i>Hideki Honda, Takafumi Kuno, Yoshiyasu Koga</i>	
Estimation of Direct Lightning Flashover Rate of Medium Voltage Distribution Lines Under Salt Pollution Condition	358
<i>Kazuyuki Ishimoto, Tomoyuki Sato</i>	
Impact of a Lightning Strike on a Low Voltage Transmission Line: A Case Study from Fujel Gorkha, Nepal	362
<i>Barun Ghimire, Shriram Sharma, Pradip Karki, Nava Raj Karki, Khem Narayan Poudyal, Chandima Gomes</i>	
Performance of Active Electrical Earthing Systems: Background and Methodology	367
<i>M. N. Hamzah, C. Gomes, M. Afiq, M. Z. A. Ab Kadir</i>	
The Calculation Model for ZnO Varistor Considering Micro-Characteristics.....	373
<i>Jingke Guo, Pengfei Meng, Zheng Liu, Wenhao Lu, Long Zhao, Xiao Lei, Shan Li</i>	

Effect of Wiring Installation System on Overvoltage at the Distribution Boards of a Building Struck Directly by Lightning	379
<i>Qianling Liu, Hisho Nakamura, Yantao Huang, Shinji Yasui, Masaya Nakagawa, Tatsuya Yamamoto</i>	
Research on Monitoring Platform of Smart SPD Based on Cloud System	384
<i>Jiawei Shen, Qibin Zhou, Bin Shao, Xiaoyan Bian, Ting Cao, Xin Huang</i>	
Development of Cost-Effective Lightning Protection Measures for Underprivileged Communities	390
<i>Chandima Gomes, Mitchell Guthrie</i>	
Air Terminal Requirement for Offshore Platform's Vent Stack: Assessment and Mitigation Plans	396
<i>Ir. S Juhaida Yusof, Ahmad Luqman Maryani</i>	
A Lightning Attachment Model to UHV Transmission Lines Based on FEM.....	401
<i>Ziwei Ma, Jasronita Jasni, Mohd Zainal Abidin Ab Kadir, Norhafiz Azis</i>	
Degradation-Diagnosis Technology for Surge Protection Device for Power Line.	407
<i>Atsushi Sato, Keiichi Saito</i>	
Simulation and Analysis on Dynamic Distribution of Space Charge of Wind Turbine Blade Tip Corona Discharge at Different Rotation Angles	412
<i>Qianhui Yang, Yeqiang Deng, Fang Chaoyin, Yu Wang, Chen Xiaoyue, Xishan Wen, Lei Lan, Jun Xu, Shaokang Chen</i>	
Modes of Lightning Attachment to Aircraft at Different Stroke Currents and Relative Positions of Descending Lightning Leader	418
<i>Sayantan Das, Udaya Kumar</i>	
Preliminary Study on Spatio-Temporal Currents in the Strokes with Long Upward Leaders	424
<i>Soumyadeep Chowdhury, A Suresh, Udaya Kumar</i>	
Lightning Resistance Test and Lightning Protection Safety Design of Glass Curtain Wall	430
<i>Jiang Xiong, Huahui Chen, Yifeng Song</i>	
Withstand Capability of MOV and GDT Parallel Combination for Excessive Impulse Currents	434
<i>Okuda Takashi, Tsukamoto Naoyuki</i>	
The Adoption of IEC 62305 Standards for Lightning Protection System in Malaysia: A Success Story	438
<i>Mohd Zainal Abidin Ab Kadir, Siow Chun Lim, Jasronita Jasni, Chandima Gomes, Iffah Hannah Muluk</i>	
A Comprehensive Reliability and Sensitivity Analysis of MS IEC 62305-2:2007 Lightning Risk Assessment Compliant Software	443
<i>Hau Lee Cheun, Chua Kein Huat, Albert Kow Kek Hing, Lim Kim Ten, Steven Chia</i>	
Cascade Protection Scheme for Wayside Signaling Surge Protection	449
<i>Lucheng Walter Wen, Chris Shaw, Spencer Teng</i>	
Common Mistakes in Lightning Protection Design and Installation	454
<i>Chua Kein Huat, Hau Lee Cheun, Albert Kow Kek Hing, Lim Kim Ten, Steven Chia, Hoo Dick Sang</i>	
A Study on Lightning Injury Mechanism and Medical Treatment Based on Case	460
<i>Qiyuan Yin, Yijun Zhang, Yiyang Zhu, Fangcong Zhou, Biao Zhu</i>	

GIS Based Map Drawing of Soil Corrosion to Power Grid Earthing Materials and Analysis of Main Influencing Factors.....	464
<i>Zhizhong Li, Weimin Xia, Hong Pan</i>	
Performance of Active Electrical Earthing Systems: Results and Discussion.....	469
<i>M. N. Hamzah, C. Gomes, M. Afiq, M. Z. A. Ab Kadir</i>	
Performance of Bentonite and Kenaf Mixtures as Grounding Enhancement Materials.....	475
<i>W. F. H. Wan Ahmad, M. H. Mohamad Roslan, J. Jasni, M. Z. A. Ab-Kadir</i>	
Performance of Bentonite and Vermiculite Mixtures as Grounding Enhancement Materials	480
<i>W. F. H. Wan Ahmad, J. Jasni, P. Krishnan, M. Z. A. Ab-Kadir</i>	
Lightning Fault Classification on Transmission Lines Using Discrete Wavelet Transform and Artificial Neural Network.....	486
<i>Azwadi Mohamad, Noradlina Abdullah, Norhasliza Mohd Hatta, Hazlie Mokhlis, Hazlee Azil Ilias, Mohd Syukri Ali</i>	
Development of Lightning Detection System Using Large-Diameter Rogowski Coil and Its Performance Evaluation Results.....	491
<i>Rikuto Tanaka, Kazuo Yamamoto</i>	
Comparative Analysis of Peak Current Prediction Based on Random Forest and MLP Neural Network Algorithms	497
<i>Priyanka Bhojar, Muhamad Safwan Abd Rahman, Sayed Ameenuddin Irfan, Ungku Anisa Ungku Amirulddin</i>	
Thunderstorm Prediction Model Using SMOTE Sampling and Machine Learning Approach	502
<i>Shirley Anak Rufus, Noor Azlinda Ahmad, Zulkurnain Abdul-Malek, Noradlina Abdullah</i>	

Author Index