

International Journal of

ISSN 0973-4562

APPLIED ENGINEERING RESEARCH

Volume 12,
Number 14,
2017

Editor-in-Chief
Prof. Ir Dr Mohd Sapuan Salit



RIP Research India Publications

<http://www.ripublication.com>

International Journal of Applied Engineering Research (IJAER)

Print ISSN 0973-4562

Online ISSN 0973-9769



Aims and Scope: The *International Journal of Applied Engineering Research (IJAER)* is an international research journal, which publishes top-level work from all areas of Engineering Research and their application including Mechanical, Civil, Electrical, Computer Science and IT, Chemical, Electronics, Mathematics, Environmental, Education Geological etc. Researchers in all technology and engineering fields are encouraged to contribute articles based on recent research. Journal publishes research articles and reviews within the whole field of Engineering Research, and it will continue to provide information on the latest trends and developments in this ever-expanding subject.

Audience: Mechanical, computer, aeronautical, chemical, civil, electronics, mathematic, geology, electrical.

Submission: Authors are requested to submit their papers electronically to IJAERditor@gmail.com

INDEXING: SCOPUS(2010-2017), EBSCOhost, GOOGLE Scholar, JournalSeek, J-Gate, ICI, Index Copernicus IC Value 82.67 and **UGC Approved Journal - 2017 (Journal No. - 64529)**

Publication Date and Frequency: Twenty four issues per year.

✚ [Publication Ethics and Publication Malpractice Statement](#)

✚ [Editorial Board Members](#)

✚ [Vol. 1 No.1 No.2 No.3](#) (2006)

✚ [Vol. 2 No.1 No.2 No.3 No.4](#) (2007)

- ✚ [Vol. 3 No.1 No.2 No.3 No.4 No.5 No.6 No.7 No.8 No.9 No.10 No.11 No.12 \(2008\)](#)
- ✚ [Vol. 4 No.1 No.2 No.3 No.4 No.5 No.6 No.7 No.8 No.9 No.10 No.11 No.12 \(2009\)](#)
- ✚ [Vol. 5 No.1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21-22 23-24 \(2010\)](#)
- ✚ [Vol. 6 No.1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23-24 \(2011\)](#)
- ✚ [Vol. 7 No.1 2 3 4 5 6 7 8 9 10 11 12 \(2012\)](#)
- ✚ [Vol. 8 No.1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 \(2013\)](#)
- ✚ [Vol. 9 No.1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 \(2014\)](#)
- ✚ [Vol.10 No.1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 \(2015\)](#)
- ✚ [Vol.11 No.1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 \(2016\)](#)
- ✚ [Vol.12 No.1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 \(2017\)](#)
- ✚ [Vol.13 No.1 No.2 \(2018\)](#)
- ✚ [Special Issues](#)
- ✚ [Authors Information](#)
- ✚ [Subscription](#)
- ✚ [Call for Papers](#)
- ✚ [Other Journals](#)
- ✚ [Library Recommendation Form](#)

© All rights are reserved with **Research India Publications**
[Contact](#)

[Home Journals](#)

International Journal of Applied Engineering Research

<http://www.ripublication.com/ijaer.htm>

Aim and Scope

The **International Journal of Applied Engineering Research (IJAER)** is an international research journal, which publishes top-level work from all areas of Engineering Research and their application including Mechanical, Civil, Electrical, Chemical, Electronics, Mathematics and Geological etc. Researchers in all technology and engineering fields are encouraged to contribute articles based on recent research. Journal publishes research articles and reviews within the whole field of Engineering Research and it will continue to provide information on the latest trends and developments in this ever-expanding subject. It aims to disseminate knowledge; provide a learned reference in the field; and establish channels of communication between academic and research experts, policy makers and executives in industry, commerce and investment institutions

Audience:

Mechanical, aeronautical, chemical, civil, electronics, mathematic, geology, electrical.

Frequency of Publication:

One Volume with twelve issues per year.

Submission of Manuscripts

Authors are strongly urged to communicate with one of the Associate Editors or the Editor-in-Chief: Prof. Ir Dr Mohd Sapuan Salit, Department of Mechanical and Manufacturing Engineering, Universiti Putra Malaysia, 43400 UPM Serdang, Selangor, Malaysia E-Mail: IJAERditor@gmail.com before submitting an article and furnish a one-page outline of the proposed article and information as to its type, audience, and probable length (limit 25 Journal pages). The final decision on publication is made by the Editor-in-Chief upon recommendation of an Associate Editor and / or an Editorial Board Members. Please visit the journal's home pages at <http://www.ripublication.com/ijaer.htm> for details of aims and scope, readership, instruction to authors and publishing procedure and table of contents. Use website to order a subscription, reprints, a sample copy or individual articles.

Subscription Rates

Outside India:

| | |
|------------------------------------|-------------|
| Library/Institutional print only | : US\$ 1160 |
| Library/Institutional online only | : US\$ 1140 |
| Library/Institutional print+online | : US\$ 1200 |
| Individual/ Personnel print only | : US\$ 580 |

Inside India (Library/Institutional):

| | |
|-----------|---------|
| Library : | Rs.5500 |
|-----------|---------|

Publisher:

All business correspondence, enquires and subscription orders should be addressed to

Editorial Office
Research India Publications
B-2/84, Ground Floor,
Rohini Sector-16,
Delhi-110089, INDIA
Fax No.: +91-011-27297815
Email: info@ripublication.com
Website: www.ripublication.com

© 2017 Research India Publication, India

Printed in India

All material published in this journal is protected by copyright, which covers exclusive rights to reproduce and distribute the material. No material published in this journal may be reproduced or stored on microfilm or in electronic, optical or magnetic form without the written authorization of the publisher.

Contents

- Integrating SSSC with Variable Structure Observer based Optimal Controller for Damping Frequency Oscillations of Deregulated Power System** 4191-4198
A. Ganga Dinesh Kumar and N.V. Ramana
- Analytical Admittance and Noise Calculations in InGaAs transistor channels** 4199-4204
Abdel Madjid Mammeri, Fatima Zohra Mahi and Luca Varani
- A Novel Feature Selection Algorithm with Dempster Shafer Fusion Information for Medical Datasets** 4205-4212
R.Naveen Kumar and Dr. M. Anand Kumar
- Building Automation and Context Aware Energy Consumption using IoT – Smart Campus** 4213-4220
Manu Jain, Asmita Varma, N Kaushik and Kayalvizhi Jayavel and Sivanathan K
- A Critical Evaluation of the Sustainability Balanced Scorecard as a Decision Aid Framework** 4221-4237
Fadwa Chaker, Mohammed Abdou Janati Idrissi, Abdellah El Manouar
- Strategy of the policy of sustainable housing development using AHP method at the village Ihamahu-Maluku, Indonesia** 4238-4247
AM. Pattinaja and Dino Rimantho
- An Appliance Door Virtual Modeling For User Experience Design** 4248-4257
Filippo Cucinotta and Felice Sfravara
- Effective Analysis of the Radio Wave's Diffraction on the Short-Circuited Crack in the Carrying-Out Screen** 4258-4263
Aleksandr V. Ostankov, Sergey A. Antipov, Konstantin A. Razinkin and Churakov P. Pavlovich
- Calculation Analysis of Power Losses on the Medium Voltage Feeders and Distribution Transformers** 4264-428:
Waluyo, Aulia Nur Fahdiyalhaq, Siti Saodah
- Visual Analytics of Millions of GPU Threads** 4282-428
SeongKi Kim and HyukSoo Han
- Neonatal Seizure Detection using Time-Frequency Renyi Entropy of HRV signals** 4286-429
M. B. Malarvili, V.Sucic and B. Boashash
- Prepare Nitinol Alloys and Improve their Hardness Using Copper as an Alloying Element** 4299-430
Salah Noori Alnomani, Essam Zuheir Fadhel and Auday Abid Mehatlaf
- Comparative Study of Five Text Classification Algorithms with their Improvements** 4309-43
Ahmed H. Aliwy and Esraa H. Abdul Ameer
- How to Determine Spot Matching Results by Probabilistic Reliability using Homogeneous Multiple Graphs in Two-Dimensional Polyacrylamide Gel Electrophoresis** 4320-43
Dae-Seong Jeoune, Chan-Myeong Han, Yun-Kyoo Ryoo, Jae Hak Sa, Beomcheol Lee and Wook Hyun Kim

International Journal of Applied Engineering Research (IJAER)

Volume 12, Number 14 (2017)

CONTENTS

[Optimization in the orientation recognition for pieces in the base mounting station belonging to the FMS200 through image processing](#)

pp. 4044-4048

Laura Quiroga, Luis Vargas and Holman Montiel

[A Comprehensive Model for Better Multicast Routing Protocol \(BMRP-QoS\) to Improve QoS in Manets](#)

pp. 4049-4055

M.Saseekala and P.Kamalakaran

[Automated Design of a Second Order Sigma Delta Modulator using Success History Based Adaptive Differential Evolution Algorithm](#)

pp. 4056-4066

Shravan Kudikala and Samrat L. Sabat

[Fatigue Life of Electrodischarge Drilled Inconel 718](#)

pp. 4067-4071

Bassoli Elena

[Adsorption of Hexavalent Chromium from Aqueous Medium Using a New Schiff Base Chitosan Derivative](#)

pp. 4072-4082

Balakrishna Prabhu K, M.B. Saidutta and M. Srinivas Kini

[FPGA Implementation of Image Denoiser using Dual Tree Complex Wavelet Transform \(DTCWT\)](#)

pp. 4083-4089

SK. Umar Faruk, K.V. Ramanaiah and K. Soundararajan

[Supervisor Control for a Stand-Alone Hybrid Generation System](#)

pp. 4090-4097

Kowsalya.M, A. Thamilmaran and P.Vijayapriya

[Block Sparse and Addressing for Memory BIST Application](#)

pp. 4098-4105

Mohammed Altaf Ahmed, D Elizabeth Rani and Syed Abdul Sattar

[Comparison of Experts and Non-Experts Gaze Pattern for the Target as Optic Disc in the Fundus Retinal Images](#)

pp. 4106-4112

Nilima Kulkarni and Amudha J

[Process Optimization of the Transesterification Processes of Palm Kernel and Soybean Oils for Lube Oil Synthesis](#)

pp. 4113-4129

Samuel E Sanni, Moses, E Emeterere, Vincent E Efeovbokhan and Joseph D Udonne

[Object Recognition Using Log-Euclidean Multivariate Gaussian Descriptors](#)

pp. 4130-4137

B. Ramesh Naik and T. Venu Gopal

[Symbol Error Probability Analysis of Quadrature Phase Shift Keying Using Hybrid Diversity Technique over Rayleigh Fading](#)

pp. 4138-4140

B. Suresh Ram and P. Siddaiah

[Evolution of High Speed Railway Communication system towards 5G: A Unique Scalable Model using Distributed Mobile Relays](#)

pp. 4141-4144

Pramod P J and B C Jinaga

[MIMO PLC Channel Modeling on Indian Residential Networks](#)

pp. 4145-4151

Shashidhar Kasthala., GKD Prasanna Venkatesan and A Amudha

[Temperament as a Determinant of Success in Formative Assessment in Engineering Education](#)

pp. 4152-4161

Kehdinga George Fomunyam and Thoko Mnisi

[A Numerical Investigation on Variable Shape Parameter Schemes in a Meshfree Method Applied to a Convection-Diffusion Problem](#)

pp. 4162-4170

Nissaya Chuathong and Sayan Kaennakham

[Environmental Effect of Climate Change Pollutants Loading on Structural Steel Stresses](#)

pp. 4171-4183

Ben U, Ngene, Anthony N, Ede, Gideon O, Bamigboye, Kumar Prashant and Imam Boulent

[An Efficient Certificateless Authentication Encryption for WSN Based on Clustering Algorithm](#)

pp. 4184-4190

Shailendra Singh Gaur, A.K. Mohapatra and Rashmi Roges

[Integrating SSSC with Variable Structure Observer based Optimal Controller for Damping Frequency Oscillations of Deregulated Power System](#)

pp. 4191-4198

A. Ganga Dinesh Kumar and N.V. Ramana

[Analytical Admittance and Noise Calculations in InGaAs transistor channels](#)

pp. 4199-4204

Abdel Madjid Mammeri, Fatima Zohra Mahi and Luca Varani

[A Novel Feature Selection Algorithm with Dempster Shafer Fusion Information for Medical Datasets](#)

pp. 4205-4212

R.Naveen Kumar and M. Anand Kumar

[Building Automation and Context Aware Energy Consumption using IoT – Smart Campus](#)

pp. 4213-4220

Manu Jain, Asmita Varma, N Kaushik, Kayalvizhi Jayavel and Sivanathan K

[A Critical Evaluation of the Sustainability Balanced Scorecard as a Decision Aid Framework](#)

pp. 4221-4237

Fadwa Chaker, Mohammed Abdou Janati Idrissi and Abdellah El Manouar

[Strategy of the policy of sustainable housing development using AHP method at the village Ihamaha-Maluku, Indonesia](#)

pp. 4238-4247

AM. Pattinaja and Dino Rimantho

[An Appliance Door Virtual Modeling For User Experience Design](#)

pp. 4248-4257

Filippo Cucinotta and Felice Sfravaraa

[Effective Analysis of the Radio Wave's Diffraction on the Short-Circuited Crack in the Carrying-Out Screen](#)

pp. 4258-4263

Aleksandr V. Ostankov, Sergey A. Antipov, Konstantin A. Razinkin and Churakov P. Pavlovich

[Calculation Analysis of Power Losses on the Medium Voltage Feeders and Distribution Transformers](#)

pp. 4264-4281

Waluyo, Aulia Nur Fahdiyalhaq and Siti Saodah

[Vishual Analytics of Millions of GPU Threads](#)

pp. 4282-4285

SeongKi Kim and HyukSoo Han

[Neonatal Seizure Detection using Time-Frequency Renyi Entropy of HRV signals](#)

pp. 4286-4298

M. B. Malarvili, V.Sucic and B. Boashash

[Prepare Nitinol Alloys and Improve their Hardness Using Copper as an Alloying Element](#)

pp. 4299-4308

Salah Noori Alnomani, Essam Zuheir Fadhel and Auday Abid Mehatlaf

[Comparative Study of Five Text Classification Algorithms with their Improvements](#)

pp. 4309-4319

Ahmed H. Aliwy and Esraa H. Abdul Ameer

[How to Determine Spot Matching Results by Probabilistic Reliability using Homogeneous Multiple Graphs in Two-Dimensional Polyacrylamide Gel Electrophoresis](#)

pp. 4320-4328

Dae-Seong Jeoune, Yun-Kyoo Ryoo, Beomcheol Lee, Chan-Myeong Han, Jae Hak Sa and Wook Hyun Kim

[An Efficient Password-Only Authenticated Three-Party Key Exchange Protocol](#)

pp. 4329-4339

Youngsook Lee, Juryon Paik and Younsung Choi

[Development of Mathematical Model of Heat and Mass Transfer in Soil, with Provision for Gradients of Soil-Water and Soil-Salt Potentials. Part 1.](#)

pp. 4340-4344

Evgeniy V. Markov, Sergey A. Pulnikov, Yuri S. Sysoev and Aleksandr D. Gerber

[An Automatic Detection of Anomalous Energy Consumption by Leveraging BEMS Big Data Analytics](#)

pp. 4345-4349

Jong Wook Kim

[A Queue-Based Energy Saving Scheme for Mobile Embedded Systems with Multiple Radio Interfaces](#)

pp. 4350-4355

Su Min Kim, Sukhyun Seo and Junsu Kim

[New Perspectives in Removal of Organic Pollutants from Industrial Wastewater mediated by the Fenton Process](#)

pp. 4356-4364

Claudia Espro, Silvia Marinia and Signorino Galvagno

[An Intelligent Radio Access Technology Selection For Vehicular Communications](#)

pp. 4365-4371

Mohanad Faeq Ali, Nor Haryati Harum and Nur Azman Abu

[Applying MDA approach for Spring MVC Framework](#)

pp. 4372-4381

Aziz Srail, Fatima Guerouatem, Naoual Berbiche and Hilal Drissi Lahsini

[Formic Acid Production from Palm Oil Empty Fruit Bunches](#)

pp. 4382-4390

Jabosar Ronggur Hamonangan Panjaitan and Misri Gozan

[Design of Anti-Sticking Membrane for RF MEMS Tunable Capacitor](#)

pp. 4391-4394

G.K. Alagashev and A.V. Gulyaev

[Development and Implementation of the Separation Method on a CMM for Decoupling](#)

[Probe Errors, Machine Errors and Roundness Errors](#)

pp. 4395-4404

Loubna Laouina, Abdelhak Nafi and Ahmed Mouchtachi

[Accessible Digital Repositories for Inclusive Education](#)

pp. 4405-4414

J. Puello, Y. Puerta and L. Martínez

[CFD Analysis of a Flat Plate Solar Collector for Improvement in Thermal Performance with Geometric Treatment of Absorber Tube](#)

pp. 4415-4421

K. Vasudeva Karanth and Jodel A. Q. Cornelio

[Anomalous Behavior on the Electrical Properties of Cu²⁺ Substitution in Li-ferrite](#)

pp. 4422-4426

Sanatombi S, Ibetombi S and Sumitra P

[Scalability Analysis using Auto-configuration process for coalescing of heterogeneous Wireless adhoc networks](#)

pp. 4427-4432

Pradeep Kumar Gaur and Anupma Marwaha

[Design of Low power Reconfiguration based Modulation and Demodulation for OFDM Communication Systems](#)

pp. 4433-4442

G. Manikandan and M. Anand

[Impact of Denial of Service \(DoS\) attack in Smart Distribution Grid Communication Network](#)

pp. 4443-4447

Premkumar S and Saminadan V

[Fast and Effective Fuzzy Parameters based cloud provisioning by means of Modified PSO](#)

pp. 4448-4454

A.Inbarajan and N. P. Gopalan

[Performance Investigation of Raman- Parametric Hybrid for Broadband Amplification in L-band](#)

pp. 4455-4459

Gaganpreet Kaur, Gurmeet Kaur and Sanjay Sharma

[Evaluation of Properties of LM 25-Alumina-Boron Carbide MMC with Different Ratios of Compositions](#)

pp. 4460-4467

T.Vishnu Vardhan, U. Nagaraju, G.Harinath Gowd and V.Ajay

[Multiple Forward Error Correction in ARQ Systems by Combining Three Consecutive Erroneous Frames in a Wireless Sensor Network](#)

pp. 4468-4473

Shylashree N and Pratibha K

[New Bimetal Bearing Shell for Internal Combustion Engine](#)

pp. 4474-4477

Yu.V. Kontsevoi, A.G. Mejlakh A.B. Shubin, E.A. Pastukhov, and I.S. Sipatov

[Strengthening of RCC Column Using Glass Fibre Reinforced Polymer \(GFRP\)](#)

pp. 4478-4483

R. Sudhakar and P. Partheeban

[Performance Optimization of Broadband Communication System using Hybrid Parametric Amplifier](#)

pp. 4484-4490

Gaganpreet Kaur, Gurmeet Kaur and Sanjay Sharma

[Optimal Power Allocation and Performance Analysis of Cooperative Multicast Systems Using Non-Orthogonal Multiple Access](#)

pp. 4491-4497

In-Ho Lee and Haejoon Jung

[A New Design of Roller Chain 415](#)

pp. 4498-4501

Ivan Yakobus, Djoko Setyanto and Isdaryanto Iskandar

[Accounting of Transportation Work in Automated Dispatching Control Systems](#)

pp. 4502-4517

Andrey B. Nikolaev, Svetlana A. Vasyugova, Andrey R. Ismailov, Leonid I. Berner and Tat'yana E. Mel'nikova

[Nonlinear Autoregressive Recurrent Neural Network Model For Solar Radiation Prediction](#)

pp. 4518-4527

Yazeed A. Al-Sbou and Khaled M. Alawasa

[Expeditious Approach to Identify the Product Sentiment Based on MORQA System and Polarity Shift Mechanism](#)

pp. 4528-4533

Vallikannu Ramanathan and T.Meyyappan

[Phytoremediation Potential of Weedy plants in Heavy Metal Contaminated Benthic Lake sludge](#)

pp. 4534-4538

Subha.M and Srinivas. N

[Kinetics of Base Catalysed Trans-Esterification of Jatropha Oil using Potassium Hydroxide Extract from Ripe Plantain Peels.](#)

pp. 4539-4548

Vincent E. Efeovbokhan, James A. Omoleye, Eric E Kalu and Joseph D. Udonne

[Assessment of Anthropometric Differences in the Design of Workstations: Case Studies of an Automotive Assembly Line](#)

pp. 4549-4555

Raffaele Castellone, Stefania Spada, Giovanni Caiazza and Maria Pia Cavatorta

[A Review of the Fundamentals on Process Capability, Process Performance, and Process Sigma, and an Introduction to Process Sigma Split](#)

pp. 4556-4570

Gabriele Arcidiacono and Stefano Nuzzi

[Stability Enhancement in Grid Integrated Real Time Wind Energy Conversion System with Compensating Devices](#)

pp. 4571-4577

Balamurugan P, Muthukannan P and Subramanian R

[A New Model for Predicting Liquid Loading in Multiphase Gas Wells](#)

pp. 4578-4586

Bolujo E.O, Fadairo A.S, Ako C.T, Orodu D.O, Omodara O.J and Emeterere M.E.

[Sectional Investigation of Seasonal Variations of Surface Refractivity and Water Vapour Density over Nigeria](#)

pp. 4587-4598

S. A. Akinwumi, T. V. Omotosho, A. A. Willoughby and M. E. Emeterere

[Decrease in Power Inputs in Pneumodrive Weighing-and-Packing Machine](#)

pp. 4599-4603

Andrey Nikolaevich Sirotenko and Svetlana Anatolievna Partko

[Physical Simulation of Near-Wellbore Rocks Temperature Reduction Process in the Earth's Interior](#)

pp. 4604-4609

A.V. Volkov, A.V. Ryzhenkov, A.V. Kurshakov, S.V. Grigoriev and V.V. Bekker

[Extreme Learning Machine: A Review](#)

pp. 4610-4623

Musatafa Abbas Abbood Albadr and Sabrina Tiun

[Controller Design and Actuator Dynamics Identification for a Hybrid Simulation Testing System](#)

pp. 4624-4630

M. Russo

[Optiimized Model for Energy Aware Location Aided Routing Protocol in MANET](#)

pp. 4631-4637

Alhraishawi Taj Aldeen Naser Abdali and Ravie Chandren Muniyandi

[Drying Processes of Wet Materials: Environmental Problem and Choice of the Theoretical, Circuitry and Experimental Directions of their Solutions](#)

pp. 4638-4643

V.V. Ryzhakov and A.O. Holudeneva

[Working Out of an Analytical Model of an Axial Bearing Taking into Account Dependence of Viscous Characteristics of Micropolar Lubrication on Pressure and Temperature](#)

pp. 4644-4650

Elena Olegovna Lagunova, Murman Aleksandrovich Mukutadze and Konstantin Sergeevich Solop

[Distributed vs Bulk Power in Distribution Systems Considering Distributed Generation](#)

pp. 4651-4657

Abdullah A. Alghamdi and Yusuf A. Al-Turki

[Application of Data Mining Techniques for the Development of 3D Laser Scan Data Management Program](#)

pp. 4658-4662

Choi, Seung Pil, Shin, Moon Seung, Yang, In Tae and Acharya and Tri Dev

[Numerical Investigation of a Liquid-Gas Ejector in Marine Ships](#)

pp. 4663-4674

Mohammed Esmail Alshebani, Khaled Alawadhi, Abdulwahab A. Alnaqi and Alaa Ahmed Saker

[Microstructural Characteristics and Mechanical Properties of Heat Treated High-Cr White Cast Iron Alloys](#)

pp. 4675-4686

Kh. Abdel-Aziz, M. El-Shennawy and Adel A. Omar

[Study on Characteristic of Laterite Soil with Lime Stabilization as a Road Foundation](#)

pp. 4687-4693

Zubair Saing, Lawalenna Samang, Tri Harianto and Johannes Patanduk

[Comparative Analysis for Strategic Minimization of the Interference in Small Cell LTE Networks](#)

pp. 4694-4698

Salah Boubkar Salah, Prinu.C.Philip, Rajeev Paulus and A.K.Jaiswal

[Performance of Laterite Soil Stabilized with Lime and Cement as a Road Foundation](#)

pp. 4699-4707

Yohanis Tulak Todingrara, M.W. Tjaronge, Tri Harianto and Muhammad Ramli

[An Energy Efficient Scheme for Detecting Redundant Readings in Cluster-based Model of Integrated RFID and Wireless Sensor Networks](#)

pp. 4708-4722

Dongcheon Shin and Seikwon Park

[Analysis on Multiple Hidden Layer Complexity of BPNN](#)

pp. 4723-4728

Stuti Asthana, Dinesh Goyal and Amitkant Pandit

[One Stage Production of Superconducting MgB₂ and Hybrid Power Transmission Lines by the Hot Shock Wave Consolidation Technology](#)

pp. 4729-4734

T. Gegechkori, B. Godibadze, V. Peikrishvili, G. Mamniashvili and A. Peikrishvili

[A Preliminary Cut-off Indoor Positioning Scheme considering the Reference Points with the](#)

Same Signal Similarity

pp. 4735-4740

Dongjun Kim and Jooyoung Son

Helical Antenna Design for Image Transfer

pp. 4741-4746

Stanislav Kovar, Hana Urbancokova, Jan Valouch, Milan Adamek and Vaclav Mach

[\[UP\]](#)

© All rights are reserved with **Research India Publications**
[Contact](#)

[Home Journals](#)

Editor-in-chief:

Prof. Ir. Dr. Mohd. Sapuan Salit

*Head, Department of Mechanical and Manufacturing Engineering
Universiti Putra Malaysia, 43400 UPM Serdang, Selangor, Malaysia.*

Editorial Board Members:

- | | |
|---------------------------------------|--|
| Zaki Ahmad, Saudi Arabia | Rajeev Ahuja, Sweden |
| Shigeru Aoki, Japan | Osama Badr, Qatar |
| Sayavur I. Bakhtiyarov, USA | FatmaAbou-Chadi, Egypt |
| Ching-Yao Chen, Taiwan | G.Q. Chen, China |
| B.T.F. Chung, USA | Tariq Darabseh, Jordan |
| Nihad Dib, Jordan | Marcelo J.S. De Lemos, Brazil |
| Mohammed Salifu, Ghana | Dimitris Drikakis, United Kingdom |
| M.R. Eslami, Iran | A.S. Al-Harthy, Australia. |
| F. Hayati, UAE | Annette Bussmann-Holder, Germany |
| Naser S. Al-Huniti, Jordan | M.A.K. Jaradat, Jordan |
| S.Z. Kassab, Egypt | M.Y. Khalil, Egypt |
| Bashar El-Khasawneh, Jordan | Y.A. Khulief, KSA |
| Kazuhiko Kudo, Japan | A. A. Mohamad |
| A. A. Mowlavi, Iran. | IhabObaidat, UAE |
| H.M. Omar, Saudi Arabia | K.K. Pathak, India |
| Huihe QIU, Hong Kong | K. R. Rajagopal, U.S.A. |
| D. Ramkrishna, USA | Allan Runstedtler, Canada |
| Ismail Shahin, United Arab Emirates | Ashraf Shikdar, Oman |
| S.A. Soliman, Qatar | JinHo Song, Korea |
| H.H. El-Tamaly, Egypt. | Bassam A. Abu-Nabah, USA |
| B.M. Vaglieco, Italy | Dimitri V. Val, Israel |
| Guo-Xiang Wang, USA | Huimin Xie, China |
| Mohamed Younes, UAE | Ahmed Sahin, Saudi Arabia |
| Samir Medik, Saudi Arabia | Meamer El Nakla, KSA |
| Adel Taha Mohamed Abbas, Saudi Arabia | Wan Aizan Wan Abd Rahman, Malaysia |
| Prof Dr Zulkifli Yusop, Malaysia | Tachtouch Bourhan, Saudi Arabia |
| Abdul Razak Rehmat, Malaysia | M. A. Habib, Saudi Arabia. |
| Fahd A. Alturki, Saudi Arabia | Prof. Abdullah M. Al-Shaalan, Saudi Arabia |
| Zeeshan Nawaz, KSA. | Mir Iqbal Faheem, India |
| M. Venkata Ramana, India | Srinivas Mantha, India. |
| Damodar Maity, India | Sellakkutti Rajendran, Singapore |
| Giriprasath Gururajan, USA. | Ram Shanmugam, USA. |

Published by

RIP Research India Publications

Head Office: B-2/84, Ground Floor, Rohini Sector-16, Delhi-110089, INDIA
Tel No.: 91-11-65394240 Fax No.: +91-011-27297815
Website: www.rippublication.com E-mail: info@rippublication.com

Editorial Board Members

Zaki Ahmad, Saudi Arabia
Rajeev Ahuja, Sweden
Shigeru Aoki, Japan
Osama Badr, Qatar
Sayavur I. Bakhtiyarov, USA
Fatma Abou-Chadi, Egypt
Ching-Yao Chen, Taiwan
G.Q. Chen, China
B.T.F. Chung, USA
Tariq Darabseh, Jordan
Nihad Dib, Jordan
Marcelo J.S. De Lemos, Brazil
Mohammed Salifu, GHANA
D. Drikakis, United Kingdom
M.R. Eslami, Iran
A.S. Al-Harthy, Australia
F. Hayati, UAE
A. Bussmann-Holder, Germany
Naser S. Al-Hunifi, JORDAN
M.A.K. Jaradat, Jordan
S.Z. Kassab, Egypt
M.Y. Khalil, Egypt
Bashar El-Khasawneh, Jordan
Y.A. Khulief, Dhahran
Kazuhiko Kudo, Japan
A. A. Mohamad,
A. A. Mowlavi, Iran
Ihab Obaidat, UAE
H.M. Omar, Saudi Arabia
K.K. Pathak, India
Huihe QIU, Hong Kong
K. R. Rajagopal, U.S.A
D. Ramkrishna, USA
Allan Runstedtler, Canada
Ismail S., United Arab Emirates
Ashraf Shikdar, Oman
S.A. Soliman, Qatar
JinHo Song, Korea
H.H. El-Tamaly, Egypt
Bassam A. Abu-Nabah, USA
B.M. Vaglieco, NaplesItaly
Dimitri V. Val, Israel
Guo-Xiang Wang, USA
Huimin Xie, China
Mohamed Younes, UAE
Ahmed Sahin, Saudi Arabia
Samir Medik, Saudi Arabia
Meamer El Nakla, KSA
A.T. M. Abbas, Saudi Arabia
W. Wan Abd Rahman, Malaysia
Prof. Dr Zulkifli Yusop, Malaysia
T. Bourhan, Saudi Arabia
Abdul Razak Rehmat, Malaysia
M. A. Habib, Saudi Arabia
Fahd A. Alturki, Saudi Arabia
A. M. Al-Shaalan, Saudi Arabia
Mir Iqbal Faheem, India
M. Venkata Ramana, India
Srinivas Mantha, India.
Damodar Maity, India
S. Rajendran, Singapore
Giriprasath Gururajan, USA
Ram Shanmugam, USA
M. Luqman, Saudi Arabia



SCOPUS Indexed Journal

International Journal of Applied Engineering Research (IJAER)

Homepage: <http://www.ripublication.com/ijaer.htm>

Print ISSN-0973-4562

Online ISSN-1087-1090



Dear Colleagues,

We would like to invite you to submit manuscripts of your original papers, for possible publication in **International Journal of Applied Engineering Research (IJAER)**.

The International Journal of Applied Engineering Research (IJAER) is an international research journal, which publishes top-level work from all areas of Engineering Research and their application including Mechanical, Civil, Electrical, Chemical, Electronics, Mathematics and Geological etc. Researchers in all technology and engineering fields are encouraged to contribute articles based on recent research. Journal publishes research articles and reviews within the whole field of Engineering Research, and it will continue to provide information on the latest trends and developments in this ever-expanding subject. More information on the journal and the publishing process can be obtained at journal homepage: www.ripublication.com/ijaer.htm

Submission: Authors are requested to submit their papers electronically to submit@ripublication.com with mention journal title (**IJAER**) in subject line.

Submit your papers by email at submit@ripublication.com

Our other International Journal which are indexed in SCOPUS

| | |
|---|----------------|
| International Journal of Oceans and Oceanography | ISSN 0973-2667 |
| International Journal of Applied Environmental Sciences | ISSN 0973-6077 |
| International Journal of Applied Chemistry | ISSN 0973-1792 |
| Global Journal of Pure and Applied Mathematics | ISSN 0973-1768 |

Author benefits:

The benefits of publishing in **International Journal of Applied Engineering Research (IJAER)** includes:

- **Fast publication times:** your paper will appear online as soon as it is ready, in advance of print version (review time of paper is 1-2 weeks)
- Excellent editorial standards
- Access free on-line issue of journal for one year
- A rigorous, fast and constructive peer review process
- All abstracts and full text available free on-line to all main universities/institutions. Worldwide ensures promotion to the widest possible audience.

We shall be glad to receive your technical contributions at your earliest convenience. Please publicize this journal amongst your colleagues for possible contribution and subscription.

With kind regards,

Editor-in-chief

International Journal of Applied Engineering Research

Research India Publications

Head Office: B-2/84, Ground Floor, Rohini Sector-16, Delhi-110 089 (INDIA)

Phone: +91-11-65394240, +91-11-27893171 • **Fax:** +91-11-27297815

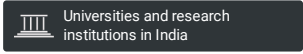
Website: www.ripublication.com • **E-mail:** info@ripublication.com

International Journal of Applied Engineering Research

Discontinued in Scopus as of 2017

COUNTRY

India



SUBJECT AREA AND CATEGORY

Engineering
└ Engineering (miscellaneous)

PUBLISHER

Research India Publications

H-INDEX

44

PUBLICATION TYPE

Journals

ISSN


09734562, 09739769

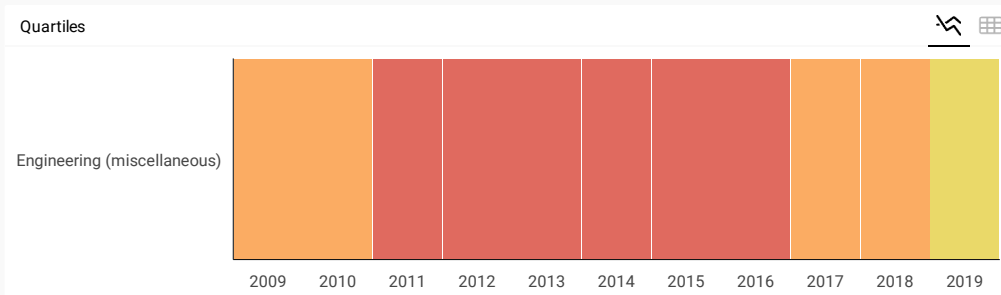
COVERAGE

2009, 2011-2018

SCOPE

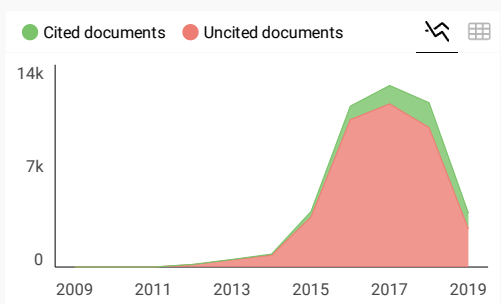
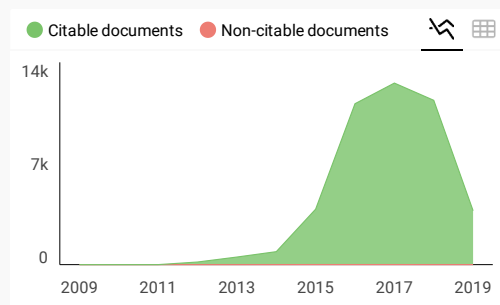
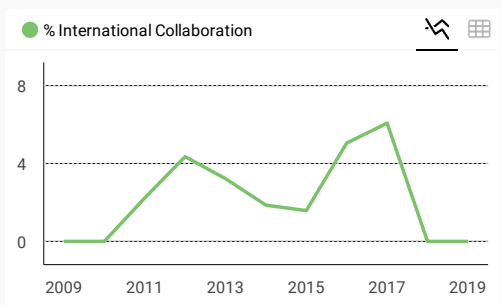
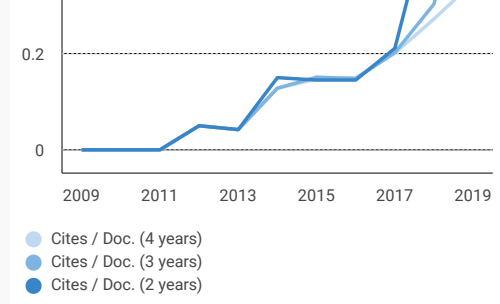
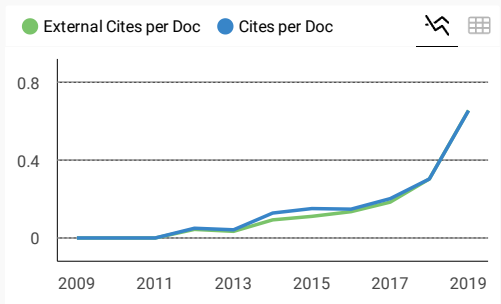
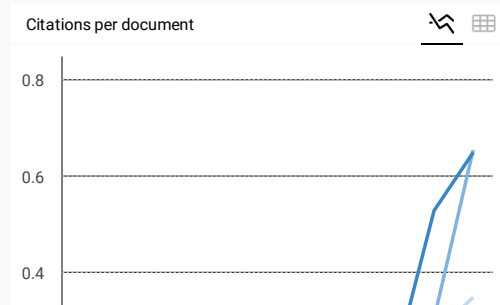
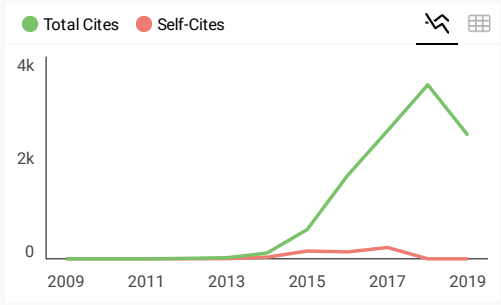
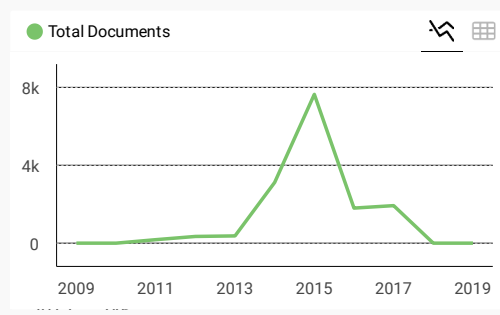
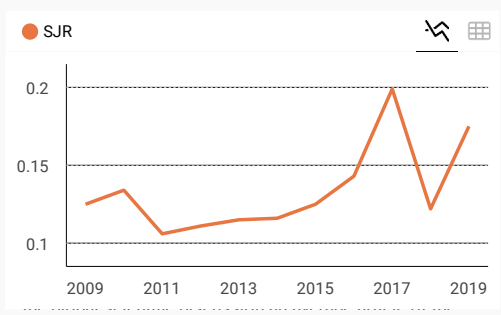
Information not localized

 Join the conversation about this journal



1
Fuzzy Sets and Systems
NLD
27%
similarity

2
Iranian Journal of Fuzzy Systems
IRN
19%
similarity



International Journal of Applied Engineering...

← Show this widget in your own website

Not yet assigned quartile

Just copy the code below and paste within your html code:

SJR 2021
0

powered by scimagojr.com

```
<a href="https://www.scimaç
```

SCImago Graphica

Explore, visually communicate and make sense of data with our **new data visualization tool**.



Ravi Bhramaramba 4 weeks ago

My article was published in International Journal of Applied Engineering and Research in 2015. Can you tell me the Quarter this Journal belongs to?

Thanks and regards

Prof. R. Bhramaramba

← reply



Melanie Ortiz 4 weeks ago

SCImago Team

Dear Ravi, thank you very much for your request. You can consult that information just above. Best Regards, SCImago Team



Dr.D.Abitha kumari 8 months ago

Dear mam, I published two articles in International Journal of Applied Engineering Research at 2015, one article indexed in Scopus, another article is not indexed in Scopus, Why?

"An Enhanced Queuing System for Multiple Mobile Elements in Wireless Sensor Network", International Journal of Applied Engineering Research, ISSN 0973-4562 Vol. 10 No.20 (2015)pp: 16019- 16023, this article indexed in Scopus.

"An Optimal Time Interval Selection and Authenticating Primary User Signal for Cognitive Radio System" International Journal of Applied Engineering Research, ISSN 0973-4562 Vol. 10 No.1 (2015) pp. 835-839, this article is not indexed in Scopus.

← reply



Melanie Ortiz 8 months ago

SCImago Team

Dear Dr.D.Abitha,
thank you very much for your comment, unfortunately we cannot help you with your request. We suggest you contact Scopus support team:
https://service.elsevier.com/app/answers/detail/a_id/14883/kw/scimago/supporthub/scopus/
Best Regards, SCImago Team



Maula 2 years ago

I would like to ask:

It mentioned discontinue as 2017. However the Quartil is still running and improving from Q4-Q3 and in 2019 is in Q2.

Does it mean that it's still in Scopus up to now?

← reply



Melanie Ortiz 2 years ago

SCImago Team

Dear Maula,

Thank you for contacting us.

The SJR reflects the data that Scopus sends us annually. The SJR is calculated for the last year, although all the information calculated for previous years can be consulted on our website. Despite the fact that a journal no longer appears in Scopus, as long as SCImago continues to receive data from Scopus related to the Citation Window (up to 3 years, necessary to calculate the SJR), the scientometric indicators are still being calculated.

Best Regards,
SCImago Team



Firas Mohammed Ali 2 years ago

Dear Authors,
Actually, this Indian publisher is predatory and is included in Beal's black list of faking journals. It targets the money of the authors rather than the quality of their work. Therefore, it was removed from the Scopus indexing. With best regards.

← reply



Miriam Edith 2 years ago

Today February 2, 2021, I checked the list that comments and the magazine "International Journal of Applied Engineering Research" does not appear.



Melanie Ortiz 2 years ago

SCImago Team

Dear Firas, thanks for your participation! Best Regards, SCImago Team



Soheir Ghonaim 2 years ago

Dear Sir,
I have paper , I would like to publish it with you .
How much money do you take ?
How many days it will take for publish?
Do you have Scopus of Thomson Reuters?

← reply



Melanie Ortiz 2 years ago

SCImago Team

Dear Soheir,
thank you for contacting us.
We are sorry to tell you that SCImago Journal & Country Rank is not a journal. SJR is a portal with scientometric indicators of journals indexed in Elsevier/Scopus.
Unfortunately, we cannot help you with your request, we suggest you visit the journal's homepage or contact the journal's editorial staff , so they could inform you more deeply.
Best Regards, SCImago Team



S.DINESHKUMAR 3 years ago

I am need to apply to this journal.If it is available in updated list?

← reply



Melanie Ortiz 3 years ago

SCImago Team

Dear Dineshkumar,

thank you for contacting us.

We are sorry to tell you that SClmago Journal & Country Rank is not a journal. SJR is a portal with scientometric indicators of journals indexed in Elsevier/Scopus.

Unfortunately, we cannot help you with your request, we suggest you to visit the journal's homepage or contact the journal's editorial staff , so they could inform you more deeply.

Best Regards, SClmago Team



rama 3 years ago

is this journal in scopus indexed.it seems there is a cancellation for some period.please clarify

← reply



pulareddy 3 years ago

concluded that it was not a scopus publisher from 2017 onwards further deatils could find at <https://www.ripublication.com/ijaer.htm>



Melanie Ortiz 3 years ago

SClMago Team

Dear Rama, thank you very much for your comment, unfortunately we cannot help you with your request. We suggest you to consult the Scopus database directly. Remember that the SJR is a static image of a database (Scopus) which is changing every day. Best regards, SClmago Team



Dr. Mohd 3 years ago

Does this Journal indexed in Scopus or still indexed as I saw that it's ongoing till 2018!

Please advice.

Thank you and Kind regards

← reply



Melanie Ortiz 3 years ago

SClMago Team

Dear Mohd, thank you very much for your comment, unfortunately we cannot help you with your request. We suggest you to consult the Scopus database directly. Remember that the SJR is a static image of a database (Scopus) which is changing every day. Best regards, SClmago Team



Jobin Jose 3 years ago

I have published a paper in International Journal of Applied Engineering Research. But my designation written in the paper is wrong. Is it possible to correct it?

← reply



Melanie Ortiz 3 years ago

SClMago Team

Dear Jobin,
thank you for contacting us.

Sorry to tell you that SClmago Journal & Country Rank is not a journal. SJR is a portal with scientometric indicators of journals indexed in Elsevier/Scopus.

Unfortunately, we cannot help you with your request, we suggest you to contact the journal's editorial staff , so they could inform you more deeply.

Best Regards, SClmago Team

M

Manjunath 3 years ago

Dear Professor, as i am looking for journal which does not charge anything for article. Hope this journal does not have any Article Processing Charges or Publication Fee. Clarify this please.

← reply



Melanie Ortiz 3 years ago

SCImago Team

Dear user,
thank you for contacting us.
Sorry to tell you that SCImago Journal & Country Rank is not a journal. SJR is a portal with scientometric indicators of journals indexed in Elsevier/Scopus.
Unfortunately, we cannot help you with your request, we suggest you to visit the journal's homepage or contact the journal's editorial staff , so they could inform you more deeply.
You can see the updated journal's information just above .
Best Regards, SCImago Team

N

Nawaraj Sanjel 3 years ago

Dear / editor

What do you mean by
1 Coverage : 2011-2017 (cancelled)
and
2. coverage : 2013 ongoing

Regards,

-

Nawaraj

← reply



Elena Corera 3 years ago

SCImago Team

Dear Nawaraj, thank you very much for your participation. Our data comes from Scopus/Elsevier, which offers an annual copy of their database. We understand that since the date indicated by Scopus/Elsevier the journal is no longer indexed in its database. While the citation window is still active, we can show indicators of the journal. Best Regards, SCImago Team

A

alhassan 4 years ago

Dear / editor

I need to ask about the difference between :

1. Coverage : 2011-2017 (cancelled)
and
2. coverage : 2013 ongoing

thanks

← reply

P

Pham Viet Hung 4 years ago

I need IJAER manuscript (MS word file)

← reply

A

Ann Vasyukova 4 years ago

You can publish a research article in your magazine? What are the requirements for the article?

Thank you.

Ann

← reply



Elena Corera 4 years ago

SCImago Team

Dear Ann Vasyukova,

Please, check comments below.

Best regards,
SCImago Team

W

Weal 4 years ago

I'm wondering about the cost of submission and publishing, is it free?

← reply



Elena Corera 4 years ago

SCImago Team

Dear Weal,

thank you very much for your comment, unfortunately we cannot help you with your request. We suggest you check author's instructions in journal website. You can find that information in SJR website <https://www.scimagojr.com>

Best Regards,
SCImago Team

W

What is the Impact Factor of IJAER ? 4 years ago

I am going to publish my research work in this journal. So, I need information on Imafact Factor.

← reply

C

chris_rj 4 years ago

in coverage, it says cancelled since 2017.so dont send your manuscript.. moreover it indicates Q3 for this.. go for journals which hav Q1 and Q2..



Elena Corera 4 years ago

SCImago Team

Dear user, SCImago Journal and Country Rank uses Scopus data, our impact indicator is the SJR. Check our page to locate the journal. We suggest you consult the Journal Citation Report for other indicators (like Impact Factor) with a Web of Science data source. Best Regards, SCImago Team

P

Pham Cao Thang 4 years ago

is IJAER in year 2018 indexed by Scopus?

← reply



Elena Corera 4 years ago

SCImago Team

Dear Pham CAo, the publication of articles of 2018 is not over yet (we are in September), and much less it has been possible to cite unpublished articles. The 2018 indicators will not be available until June 2019. We can not see what will happen in the future with this journal. SCImago receives the data from Scopus / Elsevier annually and does not have the authority to include, exclude or modify the data provided by Scopus. Best Regards, SCImago Team

N

Nader Farouk 4 years ago

I'd like to ask why journal coverage canceled.is something wrong with it

← reply



Elena Corera 4 years ago

SCImago Team

Dear user,

thank you very much for your comment. Unfortunately, we cannot help you with your request, we suggest you to contact the journal directly.

Best Regards,
SCImago Team

S

Sulaiman Alfadul 4 years ago

International Journal of Applied Engineering Research is still in your web until now>

← reply

C

chris_rj 4 years ago

see the coverage.. it says 2011 to 2017.. which means its no longer part of this database.. also it indicates Q3.. go for journals with Q1 and Q2

H

Hasan Saad 4 years ago

Dear Sir,
I have paper , I would like to publish it with you .
How can I submit ?
How much money do you take ?
How many days it will take for publish?

Yours Sincerely ,

← reply

G

Giap 4 years ago

How many magazines International Journal of Applied Engineering Research a year?

← reply



Elena Corera 4 years ago

SCImago Team

Dear Giap, we suggest you contact the journal directly. Best Regards, SCImago Team



adnan 4 years ago

good afternoon

it is very important for me knowing the impact factor of this journal

← reply



Hasan Saad 4 years ago

Dear Sir,

I have paper , I would like to publish it with you .

How much money do you take ?

How many days it will take for publish?

Do you have Scopus of Thomson Reuters?

Yours Sincerely ,



Elena Corera 4 years ago

SCImago Team

Dear Adnan, SJR uses Scopus data, our impact indicator is the SJR. Check our page to locate the journal. We suggest you consult the Journal Citation Report for other indicators with a Web of Science data source. Best Regards, SCImago Team



slamet isworo 4 years ago

please information, whether the International Journal of Applied Engineering Research including journal predatory. because I looked at BEALL'S LIST OF PREDATORY JOURNALS AND PUBLISHERS

- International Journal of Advance Engineering and Research Development (IJAERD)
- International Journal of Advanced Engineering Research and Applications (IJA-ERA)
- International Journal of Advanced Engineering Research and Science (IJAERS)
- International Journal of Agriculture and Environmental Research (IJAER)

Please input and corrections

thank you

Best regards

← reply



Fahrudin 4 years ago

thats true is International Journal of Applied Engineering Research at BEALL'S LIST OF PREDATORY JOURNALS AND PUBLISHERS



Elena Corera 4 years ago

SCImago Team

Thanks for the info!



dwi cahyani ratna sari 4 years ago

is IJAER in year 2018 indexed by Scopus?

Is IJAER in year 2018 Q3 ?

I really need the confirmation from the journal
thank you
best regards

← reply



Elena Corera 4 years ago

SCImago Team

Dear Dwi, 2018 has not ended, therefore, not all articles in the journal have been published, nor many cited. It is impossible to know which quartile will be placed in 2018. Best Regards, SCImago Team



susan 4 years ago

Can any one comment about the (cancelled) coverage of this journal?

← reply



Elena Corera 4 years ago

SCImago Team

Dear Susan, our data come from Elsevier, which offers an annual copy of your database. We understand that since the date indicated by Scopus the journal is no longer indexed in its database. Best Regards, SCImago Team



Yemi 4 years ago

Today being 23rd July, 2018, what is the scopus-indexed status of this controversial journal?

← reply



Elena Corera 4 years ago

SCImago Team

Dear Yemi, we suggest that you consult the Scopus database directly. Remember that the SJR is a static image of a database (Scopus) that changes daily. Best regards,

Leave a comment

Name

Email

(will not be published)

I'm not a robot



reCAPTCHA
Privacy - Terms

Submit

The users of Scimago Journal & Country Rank have the possibility to dialogue through comments linked to a specific journal. The purpose is to have a forum in which general doubts about the processes of publication in the journal, experiences and other issues derived from the publication of papers are resolved. For topics on particular articles, maintain the dialogue through the usual channels with your editor.

Developed by:



Powered by:



Follow us on [@ScimagoJR](#)

Scimago Lab, Copyright 2007-2022. Data Source: Scopus®

EST MODUS IN REBUS

Horatio (Satire 1,1,106)

[Edit Cookie Consent](#)



Source details

Check whether you can access Scopus remotely through your institution

[Maybe later](#) [Check access](#)

U.Z

SJR 2019
0.175

SNIP 2021
1.262

International Journal of Applied Engineering Research

Scopus coverage years: 2009, from 2011 to 2018

(coverage discontinued in Scopus)

Publisher: Research India Publications

ISSN: 0973-4562 E-ISSN: 0973-9769

Subject area: [Engineering: General Engineering](#)

Source type: Journal

[View all documents >](#)

[Set document alert](#)

[Save to source list](#)

[Source Homepage](#)

[CiteScore](#) [CiteScore rank & trend](#) [Scopus content coverage](#)

Improved CiteScore methodology

CiteScore 2016 counts the citations received in 2013-2016 to articles, reviews, conference papers, book chapters and data papers published in 2013-2016, and divides this by the number of publications published in 2013-2016. [Learn more >](#)

CiteScore **2016**

$$0.2 = \frac{2,609 \text{ Citations 2013 - 2016}}{12,165 \text{ Documents 2013 - 2016}}$$

Calculated on 01 May, 2017

CiteScore rank 2016

| Category | Rank | Percentile |
|---------------------|----------|------------|
| Engineering | | |
| General Engineering | #237/269 | 12th |

[View CiteScore methodology >](#) [CiteScore FAQ >](#) [Add CiteScore to your site >](#)

About Scopus

- [What is Scopus](#)
- [Content coverage](#)
- [Scopus blog](#)
- [Scopus API](#)
- [Privacy matters](#)

Language

- [日本語版を表示する](#)
- [查看简体中文版本](#)
- [查看繁體中文版本](#)
- [Просмотр версии на русском языке](#)

Customer Service

- [Help](#)
- [Tutorials](#)
- [Contact us](#)

ELSEVIER

[Terms and conditions >](#) [Privacy policy >](#)

Copyright © Elsevier B.V. All rights reserved. Scopus® is a registered trademark of Elsevier B.V.

We use cookies to help provide and enhance our service and tailor content. By continuing, you agree to the [use of cookies >](#).



Calculation Analysis of Power Losses on the Medium Voltage Feeders and Distribution Transformers

Waluyo¹, Aulia Nur Fahdiyahaq¹, Siti Saodah²

¹*Department of Electrical Engineering, Institut Teknologi Nasional (ITENAS) Bandung,
Jl. PHH. Mustafa No. 23 Bandung 40124 Indonesia.*

²*Department of Energy Conversion, Politeknik Negeri Bandung (POLBAN),
Jl. Gegerkalong Hilir, Ciwaruga, Bandung Barat, 40559, Indonesia.*

²*Orcid: 55604930700*

Abstract

With the increasing electric power demand, the power losses will also rise. Thus, its losses are need to be calculated accurately and become one of most important things that need to be considered in the expansion of electrical line.

This research served the method to calculate the power losses in medium voltage power distribution 20 kV includes with the result according to the load curve in every distribution transformer. The losses on the medium voltage line were calculated according to the current in the line, and the losses in transformer were calculated according to the loads those change every time. The calculated sample of feeder was taken from the power substation focused on UZB line. The loss calculations were also used by using the simulation, so that the calculations could be compared each other.

The loss result in the transformers had the biggest one, that was 5% of transformer capacity, and the biggest power loss in transformers was occurred in ALTA distribution transformer, as 5.8005% and the lowest was occurred in GKSI distribution transformer, as 0.3158%. Thus, the result could be considered to plan the electrical power distribution because they had some impact in investment.

Keywords: power loss, energy loss, medium voltage feeder, distribution transformer, distribution transformer

INTRODUCTION

To meet the electricity demand of society in a region, it is need a distribution system of plant to the consumers. The electric power distribution system that relates directly to consumers is contained in the distribution system. Therefore, the distribution system has an important role in the distribution of electrical energy to consumers.

In the distribution of electrical energy, the continuity of proper service is necessary to consumers. This will affect the

reliability of system and lead to blackouts when the system reliability is not proper, so that the consumers will feel be aggrieved. To overcome this case, the system must expand the distribution network, and one of the criteria that must be met, such as high efficiency, without ignoring the economic aspect. The high efficiency will be achieved if the energy loss can be minimized. Currently, the company is expanding the distribution network system to improve the service needs due to increasing load, the losses that occur in the network distribution system must be taken into consideration, both in planning and in operation. It will affect the cost of investment. By knowing the power loss, an enabling research was carried out on the possibility of additional investments to reduce the losses.

On the basis for the ideas, it was intended to conduct the research on power losses in the distribution network system. Therefore, it was captured the calculation analysis of power losses in the feeder on the medium voltage side, including the distribution transformers.

LITERATURE REVIEW

The losses in distribution lines are caused by line conductor losses and transformer (copper and core) losses. The losses could be reduced as possible and could be estimated. They affect voltage profiles [1-34].

Generally it was used capacitor banks for improving power factors and reducing losses [35, 36]. However, they generated harmonics, although not so high for additional losses [37]. The unbalanced and location loads would affect the feeder losses and voltage drop [38]. The regulatory authorities' penalty system would ensure better service standards for customers [39]. Power losses were also occurred in renewable energy generation, such as wind farms [40-42]. Power losses were significantly occurred in power and distribution transformers and they should be reduced as well as harmonics and unbalances [43-77].

The objectives of research in this study were to investigate the power losses in the feeder at the substation taking into account the loading curve and to provide a recommendation to minimize the losses on the network. It was limited the scope of discussion, namely the research was only used one feeder that was originated from the substation and the power loss calculations of in the distribution transformers were core and copper losses.

The states of the art of research were to calculate the power losses in the medium distribution lines and in the medium voltage sides of distribution transformer copper as well as core losses. These computations were not only in rating condition, as usual where relatively simple, but as far as in real condition in sites according to the measurement results. The computation results were compared to the simulation results. Finally, they could be analyzed by those comparisons.

METHOD OF DISTRIBUTION SYSTEM POWER LOSS CALCULATION

There were some steps to undertake the problem analysis. The process of analysis in this study was divided into several stages described schematically and systematically as shown in Figure 1.

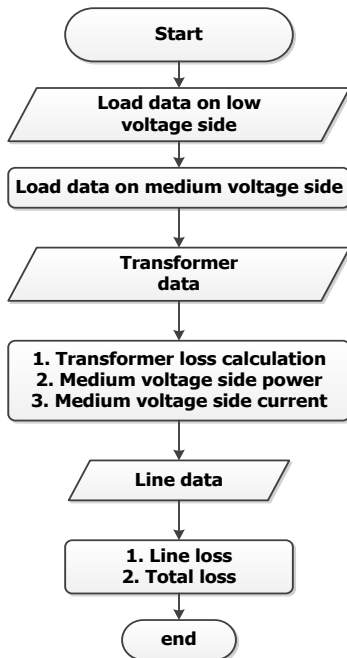


Figure 1. Flowchart of research

The next stage after the obtained data was necessary to perform data processing to determine the power losses on each phase for each distribution transformer. The steps of calculations can be described in Figure 2, which shows the power loss calculation steps along with the used formulae.

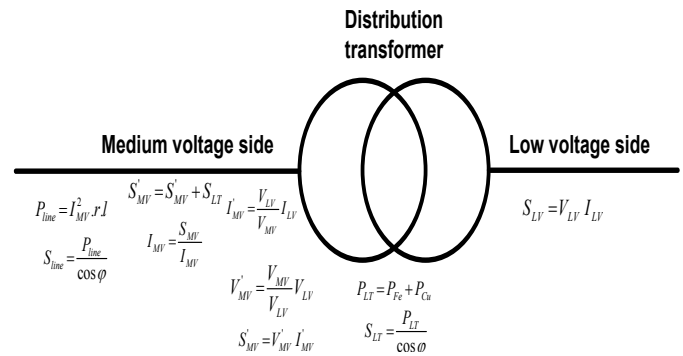


Figure 2. Steps of power loss calculations

The load data on the medium voltage side were obtained by the transformations of load parameter values on the low voltage sides and in the transformer rated voltage ratios.

$$I'_{MV} = \frac{V_{LV}}{V_{MV}} I_{LV} \quad (1)$$

$$V'_{MV} = \frac{V_{HV}}{V_{LV}} V_{LV} \quad (2)$$

$$S'_{MV} = V'_{MV} I'_{MV} \quad (3)$$

Where I_{MV} ', V_{MV} ', S_{MV} ', I_{MV} , V_{MV} , S_{MV} , V_{LV} were current load on the medium voltage side (A), voltage on the load side of medium voltage (V), power load on the medium voltage (kVA), current in the medium voltage side (A), voltage at 20 kV medium voltage (V), power at the side of medium voltage (kVA) and secondary 400 V voltage transformer (V) respectively.

The transformer capacity data and brands were acquired from the company, while the data regarding the amount of iron loss and copper loss of transformers were obtained by using the datasheets of transformers and the standard, where these losses were for the three-phase transformers.

If S_T , P_{Fe3ph} , P_{Cu3ph} were capacity transformer (kVA), iron loss (watt) and copper loss (watt) respectively, the iron loss per phase (P_{Fe1ph}) was

$$P_{Fe1ph} = \frac{P_{Fe3ph}}{3} \quad (4)$$

the copper loss per phase (P_{Cu1ph}) was

$$P_{Cu1ph} = \frac{P_{Cu3ph}}{3} \quad (5)$$

the transformer nominal current (I_n)

$$I_n = \frac{S_T}{\sqrt{3} V_{MV}} \quad (6)$$

the resistance of copper per phase (R_{Cu})

$$R_{Cu} = \frac{P_{Cu1ph}}{I_n^2} \quad (7)$$

The transformer loss was calculated per phase at each distribution transformers and on any encumbrances. The iron losses were assumed to be constant, while the copper losses depended on the load or current. The iron loss was as P_{Fe1ph} , so that the loss of copper was

$$P_{Cu} = I_{MV}'^2 R_{Cu} \quad (8)$$

The total transformer losses (P_{TL}) was

$$P_{TL} = P_{Fe1ph} + P_{Cu1ph} \quad (9)$$

The apparent transformers total loss (kVA) was

$$S_{LT} = \frac{P_{LT}}{\cos \varphi} \quad (10)$$

The transformer efficiency was

$$\eta = \frac{P}{P + P_{TL}} \times 100\% \quad (11)$$

The apparent power on the medium voltage side (kVA) was

$$S_{MV} = S_{MV}' + S_T \quad (12)$$

The current in medium voltage side was

$$I_{MV} = \frac{S_{MV}}{V_{MV}} \quad (13)$$

The cable or conductor data were obtained from the company, including the type, length, resistance and reactance. The active power loss of conductors was

$$P_{LL} = I_{MV}^2 r l \quad (14)$$

The apparent power loss of conductors was

$$S_{LL} = \frac{P_{LL}}{\cos \varphi} \quad (15)$$

The efficiency line was

$$\eta_{LL} = \frac{P_{MV} - P_{LL}}{P_{MV}} \times 100\% \quad (16)$$

The total losses were the transformer losses and distribution line loss between X and Y as

$$P_{LTot} = P_{LT} + P_{LL} \quad (17)$$

The power transformer losses could be written by the following equation as

$$P_{LT} = P_{Fe} + P_{Cu} \quad (18)$$

DATA, RESULTS AND DISCUSSION

The used networks in the calculation of power losses were the medium voltage of UZB feeder, using the medium voltage cable, as shown in Figure 3.

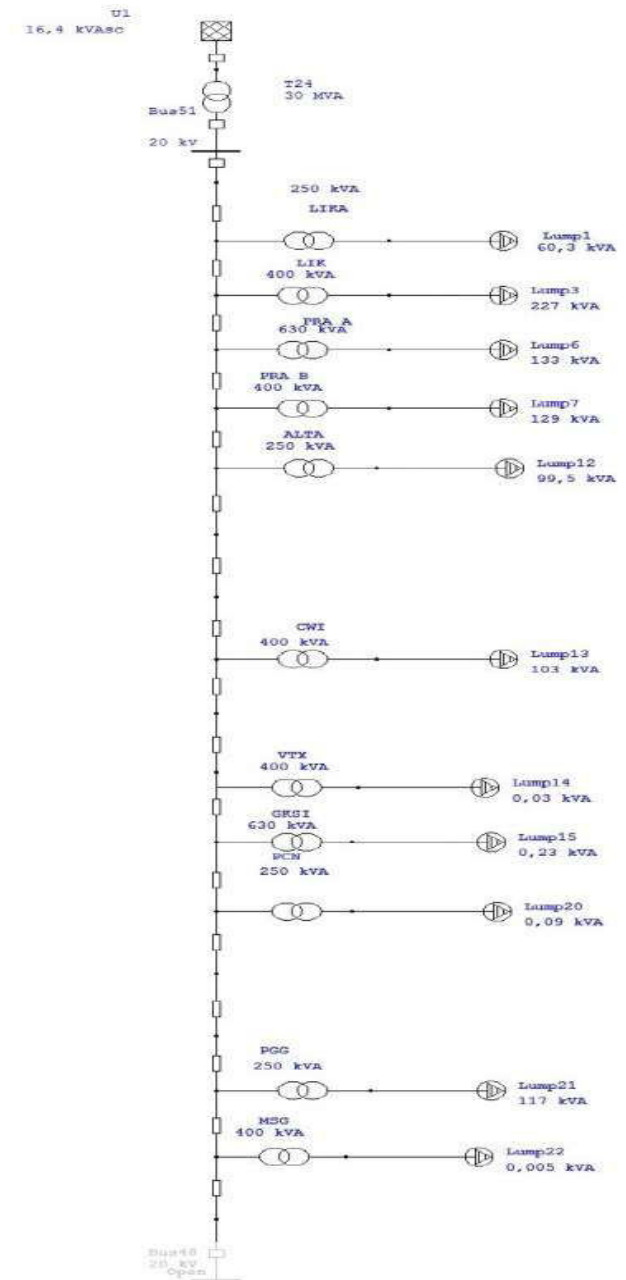


Figure 3. Network system feeder of UZB

Table 1 list the data of conductor feeder UZB that be investigated. The longest line was between PGG and OGA, as 2,402 m and the shortest one was between PRA B and ALTA as 32 m, where the resistances were 0.124 Ω /km for all feeder conductors.

Table 1: Data of conductor feeder UZB

| No | Distribution transformer | | Length (m) |
|----|--------------------------|-------|------------|
| | Beginning | End | |
| 1 | H | LIKA | 411 |
| 2 | LIKA | LIK | 347 |
| 3 | LIK | PRA A | 1070 |
| 4 | PRA A | PRA B | 60 |
| 5 | PRA B | ALTA | 32 |
| 6 | ALTA | CWI | 254 |
| 7 | CWI | VTX | 483 |
| 8 | VTX | GKSI | 86 |
| 9 | GKSI | PCN | 409 |
| 10 | PCN | MSG | 273 |
| 11 | MSG | PGG | 275 |
| 12 | PGG | OGA | 2402 |

The distribution transformer data were necessary to calculate power losses in the distribution transformers for each load condition. The distribution transformer data can be shown in Table 2. The table lists that the highest transformer capacity was 1 300 kVA, as PRA A, GKSI, MSG and OGA distribution transformers. The copper resistances and the power factors were assumed 0.02 Ω and 0.8 lagging respectively.

Table 2: Distribution transformer data for feeder UZB

| No | Distribution transformer | Transformer capacity (kVA) | Core loss (Watt) |
|----|--------------------------|----------------------------|------------------|
| 1 | LIKA | 250 | 600 |
| 2 | LIK | 400 | 930 |
| 3 | PRA A | 630 | 1300 |
| 4 | PRA B | 400 | 930 |
| 5 | ALTA | 250 | 600 |
| 6 | CWI | 400 | 930 |
| 7 | VTX | 400 | 930 |
| 8 | GKSI | 630 | 1300 |
| 9 | PCN | 250 | 600 |
| 10 | MSG | 630 | 1300 |
| 11 | PGG | 250 | 600 |
| 12 | OGA | 630 | 1300 |

The load data were the amount of use of electrical load (current), which were obtained by the measurements every distribution transformer. The load data can be seen in Table 3 for LIKA distribution transformer. The highest currents were

occurred in 18:00 and 19:00 o'clocks, as 103 A and 104 A for phase-S, 91 A and 92 A for load data phase-R and phase-T, respectively.

Table 3: Measurement of distribution transformer of LIKA

| Hours | Phase Current (A) | | | Phase Voltage (V) | | |
|-------|-------------------|-----|----|-------------------|-----|-----|
| | R | S | T | R | S | T |
| 0:00 | 87 | 95 | 83 | 223 | 223 | 224 |
| 1:00 | 84 | 96 | 84 | 222 | 222 | 221 |
| 2:00 | 81 | 93 | 81 | 224 | 224 | 223 |
| 3:00 | 80 | 92 | 80 | 225 | 225 | 224 |
| 4:00 | 82 | 94 | 82 | 226 | 226 | 225 |
| 5:00 | 79 | 91 | 79 | 224 | 224 | 223 |
| 6:00 | 83 | 95 | 83 | 226 | 226 | 225 |
| 7:00 | 81 | 93 | 81 | 228 | 228 | 227 |
| 8:00 | 79 | 91 | 79 | 227 | 227 | 226 |
| 9:00 | 82 | 94 | 82 | 226 | 225 | 224 |
| 10:00 | 85 | 97 | 85 | 225 | 224 | 223 |
| 11:00 | 87 | 99 | 87 | 227 | 226 | 225 |
| 12:00 | 87 | 99 | 87 | 227 | 226 | 225 |
| 13:00 | 87 | 99 | 87 | 227 | 226 | 225 |
| 14:00 | 89 | 101 | 89 | 228 | 227 | 225 |
| 15:00 | 85 | 97 | 85 | 224 | 222 | 225 |
| 16:00 | 88 | 100 | 88 | 225 | 223 | 222 |
| 17:00 | 86 | 98 | 86 | 227 | 225 | 224 |
| 18:00 | 91 | 103 | 91 | 231 | 231 | 231 |
| 19:00 | 92 | 104 | 92 | 231 | 231 | 231 |
| 20:00 | 91 | 99 | 87 | 228 | 228 | 227 |
| 21:00 | 86 | 94 | 82 | 229 | 229 | 228 |
| 22:00 | 92 | 100 | 88 | 230 | 230 | 229 |
| 23:00 | 90 | 98 | 86 | 225 | 225 | 224 |

Table 4 lists the load data for LIK distribution transformer. The highest currents were occurred in 18:00 and 19:00 o'clocks, as 315 A and 316 A for phase-S, 350 A and 351 A for phase-R and 389 A and 390 A for phase-T, respectively.

Table 4: Load data of distribution transformer LIK

| Hours | Phase Current (A) | | | Phase Voltage (V) | | |
|-------|-------------------|-----|-----|-------------------|-----|-----|
| | R | S | T | R | S | T |
| 0:00 | 346 | 307 | 381 | 223 | 222 | 221 |
| 1:00 | 343 | 308 | 382 | 220 | 219 | 218 |
| 2:00 | 340 | 305 | 379 | 221 | 220 | 219 |
| 3:00 | 339 | 304 | 378 | 222 | 221 | 220 |
| 4:00 | 341 | 306 | 380 | 223 | 222 | 221 |
| 5:00 | 338 | 303 | 377 | 219 | 218 | 217 |
| 6:00 | 342 | 307 | 381 | 220 | 219 | 218 |
| 7:00 | 340 | 305 | 379 | 221 | 220 | 219 |
| 8:00 | 338 | 303 | 377 | 218 | 217 | 216 |
| 9:00 | 341 | 306 | 380 | 216 | 215 | 214 |
| 10:00 | 344 | 309 | 383 | 214 | 213 | 212 |
| 11:00 | 346 | 311 | 385 | 217 | 216 | 215 |
| 12:00 | 346 | 311 | 385 | 217 | 216 | 215 |
| 13:00 | 346 | 311 | 385 | 217 | 216 | 215 |
| 14:00 | 348 | 313 | 387 | 217 | 216 | 215 |
| 15:00 | 344 | 309 | 383 | 217 | 217 | 211 |
| 16:00 | 347 | 312 | 386 | 225 | 226 | 226 |
| 17:00 | 345 | 310 | 384 | 226 | 227 | 227 |
| 18:00 | 350 | 315 | 389 | 212 | 215 | 215 |
| 19:00 | 351 | 316 | 390 | 228 | 228 | 228 |
| 20:00 | 350 | 311 | 385 | 222 | 221 | 220 |
| 21:00 | 345 | 306 | 380 | 223 | 222 | 221 |
| 22:00 | 351 | 312 | 386 | 224 | 223 | 222 |
| 23:00 | 349 | 310 | 384 | 222 | 221 | 220 |

Table 5 lists the load data for PRA A distribution transformer. The highest currents were occurred in 18:00 and 19:00 o'clocks, as 214 A and 219 A for phase-S, 207 A and 208 A for phase-R and 195 A and 196 A for phase-T, respectively.

Table 5: Load data of distribution transformer PRA A

| Hours | Phase Current (A) | | | Phase Voltage (V) | | |
|-------|-------------------|-----|-----|-------------------|-----|-----|
| | R | S | T | R | S | T |
| 0:00 | 203 | 211 | 187 | 217 | 221 | 222 |
| 1:00 | 200 | 212 | 188 | 215 | 219 | 220 |
| 2:00 | 197 | 209 | 185 | 216 | 220 | 221 |
| 3:00 | 196 | 208 | 184 | 217 | 221 | 222 |
| 4:00 | 198 | 210 | 186 | 218 | 222 | 223 |
| 5:00 | 195 | 207 | 183 | 214 | 218 | 219 |
| 6:00 | 199 | 211 | 187 | 216 | 220 | 221 |
| 7:00 | 197 | 209 | 185 | 217 | 221 | 222 |
| 8:00 | 195 | 207 | 183 | 215 | 219 | 220 |
| 9:00 | 198 | 210 | 186 | 214 | 218 | 219 |
| 10:00 | 201 | 213 | 189 | 213 | 217 | 218 |
| 11:00 | 203 | 215 | 191 | 216 | 220 | 221 |
| 12:00 | 203 | 215 | 191 | 216 | 220 | 221 |
| 13:00 | 203 | 215 | 191 | 216 | 220 | 221 |
| 14:00 | 205 | 217 | 193 | 218 | 222 | 223 |
| 15:00 | 201 | 213 | 189 | 225 | 222 | 223 |
| 16:00 | 204 | 216 | 192 | 229 | 229 | 229 |
| 17:00 | 202 | 214 | 190 | 229 | 229 | 229 |
| 18:00 | 207 | 219 | 195 | 229 | 229 | 229 |
| 19:00 | 208 | 220 | 196 | 222 | 221 | 227 |
| 20:00 | 207 | 215 | 191 | 215 | 217 | 214 |
| 21:00 | 202 | 210 | 186 | 219 | 223 | 224 |
| 22:00 | 208 | 216 | 192 | 220 | 224 | 225 |
| 23:00 | 206 | 214 | 190 | 216 | 220 | 221 |

Table 6 lists the load data for PRA B distribution transformer. The highest currents were occurred in 18:00 and 19:00 o'clocks, as 193 A and 194 A for phase-S, 184 A and 185 A for phase-R and 216 A and 217 A for phase-T, respectively. In this distribution transformer, the current in phase-T was higher than that in phase-S.

Table 7 lists the load data for ALTA distribution transformer. The highest currents were occurred in 18:00 and 19:00 o'clocks, as 133 A and 134 A for phase-S, 126 A and 127 A for phase-R and 193 A and 194 A for phase-T, respectively. In this distribution transformer, the current in phase-T was higher than that in phase-S.

Table 6: Load data of distribution transformer PRA B

| Hours | Phase Current (A) | | | Phase Voltage (V) | | |
|-------|-------------------|-----|-----|-------------------|-----|-----|
| | R | S | T | R | S | T |
| 0:00 | 180 | 185 | 208 | 226 | 227 | 225 |
| 1:00 | 177 | 186 | 209 | 222 | 223 | 221 |
| 2:00 | 174 | 183 | 206 | 223 | 224 | 222 |
| 3:00 | 173 | 182 | 205 | 224 | 225 | 223 |
| 4:00 | 175 | 184 | 207 | 225 | 226 | 224 |
| 5:00 | 172 | 181 | 204 | 220 | 221 | 219 |
| 6:00 | 176 | 185 | 208 | 222 | 223 | 221 |
| 7:00 | 174 | 183 | 206 | 223 | 224 | 222 |
| 8:00 | 172 | 181 | 204 | 222 | 223 | 221 |
| 9:00 | 175 | 184 | 207 | 221 | 222 | 220 |
| 10:00 | 178 | 187 | 210 | 220 | 221 | 219 |
| 11:00 | 180 | 189 | 212 | 224 | 225 | 223 |
| 12:00 | 180 | 189 | 212 | 224 | 225 | 223 |
| 13:00 | 180 | 189 | 212 | 224 | 225 | 223 |
| 14:00 | 182 | 191 | 214 | 226 | 227 | 225 |
| 15:00 | 178 | 187 | 210 | 217 | 219 | 216 |
| 16:00 | 181 | 190 | 213 | 223 | 221 | 222 |
| 17:00 | 179 | 188 | 211 | 225 | 223 | 224 |
| 18:00 | 184 | 193 | 216 | 231 | 231 | 231 |
| 19:00 | 185 | 194 | 217 | 231 | 231 | 231 |
| 20:00 | 184 | 189 | 212 | 231 | 231 | 231 |
| 21:00 | 179 | 184 | 207 | 223 | 224 | 222 |
| 22:00 | 185 | 190 | 213 | 225 | 226 | 224 |
| 23:00 | 183 | 188 | 211 | 224 | 225 | 223 |

Table 7: Load data of distribution transformer ALTA

| Hours | Phase Current (A) | | | Phase Voltage (V) | | |
|-------|-------------------|-----|-----|-------------------|-----|-----|
| | R | S | T | R | S | T |
| 0:00 | 122 | 129 | 182 | 231 | 231 | 231 |
| 1:00 | 119 | 126 | 186 | 229 | 229 | 229 |
| 2:00 | 116 | 123 | 183 | 230 | 230 | 230 |
| 3:00 | 115 | 122 | 182 | 231 | 231 | 231 |
| 4:00 | 117 | 124 | 184 | 232 | 232 | 232 |
| 5:00 | 114 | 121 | 181 | 230 | 230 | 230 |
| 6:00 | 118 | 125 | 185 | 231 | 231 | 231 |
| 7:00 | 116 | 123 | 183 | 231 | 231 | 231 |
| 8:00 | 114 | 121 | 181 | 229 | 229 | 229 |
| 9:00 | 117 | 124 | 184 | 227 | 227 | 227 |
| 10:00 | 120 | 127 | 187 | 225 | 225 | 225 |
| 11:00 | 122 | 129 | 189 | 228 | 228 | 228 |
| 12:00 | 122 | 129 | 189 | 229 | 229 | 229 |
| 13:00 | 122 | 129 | 189 | 230 | 230 | 230 |
| 14:00 | 124 | 131 | 191 | 231 | 231 | 231 |
| 15:00 | 120 | 127 | 187 | 215 | 214 | 206 |
| 16:00 | 123 | 130 | 190 | 225 | 220 | 215 |
| 17:00 | 121 | 128 | 188 | 229 | 228 | 220 |
| 18:00 | 126 | 133 | 193 | 231 | 231 | 231 |
| 19:00 | 127 | 134 | 194 | 231 | 231 | 231 |
| 20:00 | 125 | 132 | 192 | 231 | 231 | 231 |
| 21:00 | 120 | 127 | 187 | 232 | 232 | 232 |
| 22:00 | 126 | 133 | 193 | 233 | 233 | 233 |
| 23:00 | 124 | 131 | 191 | 230 | 230 | 230 |

Table 8 lists the load data for CWI distribution transformer. The highest currents were occurred at 18:00 o'clock as 205 A, 180 A and 200 A for phase R, S and T respectively, and at 19:00 o'clocks, as 192 A, 169 A and 187 A for phase-S, 126 A and 127 A for phase-R and 193 A and 194 A for phase-T, respectively. In this distribution transformer, the current in phase-R was higher than that in phase-S.

Table 8 Load data of distribution transformer CWI

| Hours | Phase Current (A) | | | Phase Voltage (V) | | |
|-------|-------------------|-----|-----|-------------------|-----|-----|
| | R | S | T | R | S | T |
| 0:00 | 125 | 108 | 120 | 214 | 213 | 212 |
| 1:00 | 125 | 108 | 120 | 215 | 215 | 215 |
| 2:00 | 128 | 113 | 123 | 216 | 216 | 216 |
| 3:00 | 129 | 114 | 124 | 216 | 216 | 216 |
| 4:00 | 127 | 112 | 122 | 216 | 216 | 216 |
| 5:00 | 130 | 115 | 125 | 215 | 215 | 215 |
| 6:00 | 180 | 165 | 175 | 215 | 215 | 215 |
| 7:00 | 180 | 165 | 175 | 215 | 215 | 215 |
| 8:00 | 184 | 169 | 179 | 209 | 209 | 209 |
| 9:00 | 190 | 170 | 185 | 214 | 214 | 214 |
| 10:00 | 196 | 177 | 191 | 218 | 218 | 218 |
| 11:00 | 173 | 150 | 168 | 215 | 215 | 215 |
| 12:00 | 170 | 147 | 165 | 218 | 218 | 218 |
| 13:00 | 167 | 142 | 162 | 218 | 218 | 218 |
| 14:00 | 160 | 138 | 155 | 218 | 218 | 218 |
| 15:00 | 158 | 126 | 153 | 207 | 209 | 207 |
| 16:00 | 168 | 143 | 163 | 228 | 228 | 228 |
| 17:00 | 187 | 173 | 182 | 220 | 220 | 220 |
| 18:00 | 205 | 180 | 200 | 228 | 228 | 228 |
| 19:00 | 192 | 169 | 187 | 228 | 228 | 228 |
| 20:00 | 198 | 179 | 193 | 228 | 228 | 228 |
| 21:00 | 196 | 177 | 191 | 228 | 228 | 228 |
| 22:00 | 176 | 153 | 171 | 225 | 225 | 225 |
| 23:00 | 144 | 128 | 139 | 225 | 225 | 225 |

Table 9 lists the load data for VTX distribution transformer. The high currents, for all R, S and T phases, were distributed in some hours, not only on one or two hour(s). The currents

those had higher values than 150 ampere were occurred at 00:00, 01:00, 02:00, 03:00, 05:00, 09:00, 11:00, 18:00 and 22:00, as well as for nearly 150 ampere it was at 23:00 on each phase. Thus, the time range where the current values were high was from 22:00 until 03:00. This case was reasonable because the feeder supplied almost the industry.

Table 9 Load data of distribution transformer VTX

| Hours | Phase Current (A) | | | Phase Voltage (V) | | |
|-------|-------------------|------------|------------|-------------------|--------|--------|
| | R | S | T | R | S | T |
| 0:00 | 171 | 173 | 221 | 223.66 | 225.72 | 225.32 |
| 1:00 | 155 | 161 | 203 | 221.71 | 223.65 | 223.34 |
| 2:00 | 163 | 167 | 212 | 221.90 | 223.82 | 223.38 |
| 3:00 | 153 | 159 | 203 | 223.58 | 225.48 | 224.93 |
| 4:00 | 134 | 140 | 181 | 223.57 | 225.47 | 224.92 |
| 5:00 | 151 | 156 | 197 | 221.14 | 223.12 | 222.82 |
| 6:00 | 111 | 118 | 157 | 223.52 | 225.44 | 224.98 |
| 7:00 | 126 | 127 | 172 | 224.10 | 225.96 | 225.46 |
| 8:00 | 136 | 133 | 179 | 221.87 | 223.87 | 223.36 |
| 9:00 | 150 | 151 | 193 | 220.59 | 222.57 | 222.10 |
| 10:00 | 118 | 122 | 162 | 219.52 | 221.50 | 221.04 |
| 11:00 | 154 | 152 | 196 | 219.94 | 221.99 | 221.54 |
| 12:00 | 121 | 124 | 166 | 220.42 | 222.43 | 221.94 |
| 13:00 | 121 | 124 | 166 | 219.95 | 221.95 | 221.54 |
| 14:00 | 132 | 131 | 174 | 220.25 | 222.32 | 221.89 |
| 15:00 | 137 | 135 | 179 | 219.97 | 222.11 | 221.64 |
| 16:00 | 123 | 122 | 167 | 221.78 | 223.79 | 223.33 |
| 17:00 | 129 | 130 | 171 | 222.12 | 224.20 | 223.85 |
| 18:00 | 154 | 156 | 197 | 220.07 | 222.37 | 222.22 |
| 19:00 | 127 | 132 | 172 | 220.01 | 222.35 | 222.13 |
| 20:00 | 128 | 132 | 173 | 220.48 | 222.71 | 222.50 |
| 21:00 | 126 | 131 | 172 | 221.93 | 224.11 | 223.95 |
| 22:00 | 160 | 160 | 204 | 223.11 | 225.15 | 224.81 |
| 23:00 | 147 | 149 | 193 | 222.71 | 224.69 | 224.28 |

Table 10 lists the load data for GKSI distribution transformer. The highest currents were occurred at 14:00 o'clock as 288.2, 308.6 and 288.4 amperes for phase R, S and T respectively, and at 16:00 o'clocks, as 289, 308.4 and 288.4 amperes for

phase-S, phase-R and phase-T, respectively. Thus, in this distribution transformer, the high currents were occurred in 14:00 and 16:00 o'clocks in ranges. This case was not usual than other ones.

Table 10: Load data of distribution transformer GKSI

| Hours | Phase Current (A) | | | Phase Voltage (V) | | |
|-------|-------------------|-------|-------|-------------------|--------|--------|
| | R | S | T | R | S | T |
| 0:00 | 265.4 | 297.4 | 277.4 | 223.55 | 225.57 | 225.13 |
| 1:00 | 277.2 | 298.8 | 280.0 | 221.62 | 223.52 | 223.12 |
| 2:00 | 262.2 | 282.6 | 263.8 | 221.94 | 223.79 | 223.28 |
| 3:00 | 253.6 | 273.6 | 254.0 | 223.30 | 225.24 | 224.69 |
| 4:00 | 254.4 | 274.8 | 254.8 | 223.41 | 225.33 | 224.79 |
| 5:00 | 193.8 | 210.4 | 193.8 | 221.35 | 223.30 | 222.87 |
| 6:00 | 204.4 | 220.6 | 202.2 | 223.25 | 225.13 | 224.70 |
| 7:00 | 199.0 | 214.4 | 195.8 | 224.31 | 226.17 | 225.63 |
| 8:00 | 193.2 | 208.2 | 189.8 | 222.05 | 223.97 | 223.41 |
| 9:00 | 232.6 | 253.0 | 232.8 | 220.96 | 222.87 | 222.29 |
| 10:00 | 255.4 | 273.4 | 253.6 | 219.53 | 221.50 | 220.94 |
| 11:00 | 274.2 | 294.2 | 274.4 | 219.67 | 221.68 | 221.20 |
| 12:00 | 282.6 | 302.4 | 283.0 | 220.53 | 222.48 | 221.94 |
| 13:00 | 280.8 | 302.4 | 281.0 | 220.00 | 221.98 | 221.48 |
| 14:00 | 288.2 | 308.6 | 288.4 | 220.17 | 222.19 | 221.65 |
| 15:00 | 285.2 | 305.8 | 285.6 | 220.18 | 222.20 | 221.67 |
| 16:00 | 289.0 | 308.4 | 288.4 | 220.81 | 222.78 | 222.23 |
| 17:00 | 278.8 | 299.8 | 279.2 | 222.32 | 224.33 | 223.88 |
| 18:00 | 274.6 | 299.8 | 279.2 | 220.02 | 222.27 | 222.11 |
| 19:00 | 280.0 | 305 | 284.2 | 219.87 | 222.12 | 221.96 |
| 20:00 | 277.8 | 303 | 281.4 | 220.19 | 222.41 | 222.19 |
| 21:00 | 274.0 | 297.8 | 276.6 | 221.83 | 224.00 | 223.68 |
| 22:00 | 282.6 | 306.4 | 285.2 | 223.76 | 225.78 | 225.41 |
| 23:00 | 277.6 | 298.2 | 279.2 | 222.99 | 224.89 | 224.45 |

Table 11 lists the load data for PCN distribution transformer. The highest currents were occurred at 00:00 o'clock as 306.8,

319.2 and 358.4 amperes for phase R, S and T respectively, and at 01:00 o'clocks, as 297.2, 310.8 and 350.0 ampere for phase-S, phase-R and phase-T, respectively. Thus, in this distribution transformer, the high currents were occurred in 00:00 and 01:00 o'clocks in ranges. This case was not usual than other ones.

Table 11: Load data of distribution transformer PCN

| Hours | Phase Current (A) | | | Phase Voltage (V) | | |
|-------|-------------------|--------------|--------------|-------------------|--------|--------|
| | R | S | T | R | S | T |
| 0:00 | 306.8 | 319.2 | 358.4 | 223.94 | 222.25 | 224.26 |
| 1:00 | 297.2 | 310.8 | 350.0 | 225.22 | 223.60 | 225.43 |
| 2:00 | 278.4 | 292.8 | 326.0 | 222.57 | 221.08 | 222.89 |
| 3:00 | 294.4 | 308.8 | 343.6 | 223.65 | 222.24 | 223.99 |
| 4:00 | 256.4 | 272.4 | 307.6 | 224.29 | 222.87 | 224.59 |
| 5:00 | 237.2 | 245.2 | 284.8 | 222.67 | 221.14 | 223.04 |
| 6:00 | 141.2 | 132.8 | 185.6 | 223.20 | 221.62 | 223.46 |
| 7:00 | 175.6 | 170.4 | 226.4 | 225.06 | 223.72 | 225.46 |
| 8:00 | 169.6 | 164.0 | 218.4 | 223.94 | 222.43 | 224.20 |
| 9:00 | 132.0 | 127.6 | 173.2 | 222.45 | 221.00 | 222.83 |
| 10:00 | 146.8 | 153.6 | 193.2 | 221.01 | 219.60 | 221.34 |
| 11:00 | 139.2 | 144.8 | 184 | 220.46 | 218.93 | 220.74 |
| 12:00 | 139.6 | 148.4 | 187.6 | 221.25 | 219.77 | 221.59 |
| 13:00 | 150.0 | 160.4 | 198.8 | 221.28 | 219.81 | 221.67 |
| 14:00 | 143.2 | 151.6 | 190.4 | 221.07 | 219.52 | 221.40 |
| 15:00 | 124.4 | 126.8 | 166.4 | 221.31 | 219.75 | 221.66 |
| 16:00 | 143.2 | 151.2 | 191.6 | 221.19 | 219.60 | 221.50 |
| 17:00 | 149.6 | 150.8 | 197.6 | 223.53 | 221.96 | 223.80 |
| 18:00 | 134.4 | 122.8 | 171.2 | 221.75 | 219.73 | 221.82 |
| 19:00 | 132.4 | 120.8 | 168.8 | 221.29 | 219.20 | 221.31 |
| 20:00 | 135.2 | 123.6 | 172.4 | 221.72 | 219.70 | 221.82 |
| 21:00 | 142.8 | 130.4 | 183.6 | 222.48 | 220.50 | 222.60 |
| 22:00 | 150.8 | 138.8 | 191.6 | 223.97 | 222.13 | 224.12 |
| 23:00 | 155.2 | 144.4 | 197.6 | 224.45 | 222.86 | 224.65 |

Table 12 lists the load data for PGG distribution transformer. The highest currents were occurred at 18:00 o'clock as 146, 172 and 233 amperes for phase R, S and T respectively, and at 19:00 o'clocks, as 147 A, 173 A and 234 A for phase-S, phase-R and phase-T, respectively.

Table 12: Load data of distribution transformer PGG

| Time | Phase Current (A) | | | Phase Voltage (V) | | |
|-------|-------------------|------------|------------|-------------------|-----|-----|
| | R | S | T | R | S | T |
| | 0:00 | 142 | 164 | 225 | 221 | 218 |
| 1:00 | 139 | 165 | 226 | 219 | 216 | 213 |
| 2:00 | 136 | 162 | 223 | 220 | 217 | 214 |
| 3:00 | 135 | 161 | 222 | 221 | 218 | 215 |
| 4:00 | 137 | 163 | 224 | 222 | 219 | 216 |
| 5:00 | 134 | 160 | 221 | 218 | 215 | 212 |
| 6:00 | 138 | 164 | 225 | 219 | 216 | 213 |
| 7:00 | 136 | 162 | 223 | 220 | 217 | 214 |
| 8:00 | 134 | 160 | 221 | 219 | 216 | 213 |
| 9:00 | 137 | 163 | 224 | 218 | 215 | 212 |
| 10:00 | 140 | 166 | 227 | 217 | 214 | 211 |
| 11:00 | 142 | 168 | 229 | 220 | 217 | 214 |
| 12:00 | 142 | 168 | 229 | 220 | 217 | 214 |
| 13:00 | 142 | 168 | 229 | 220 | 217 | 214 |
| 14:00 | 144 | 170 | 231 | 225 | 222 | 214 |
| 15:00 | 140 | 166 | 227 | 230 | 231 | 231 |
| 16:00 | 143 | 169 | 230 | 229 | 229 | 227 |
| 17:00 | 141 | 167 | 228 | 230 | 230 | 228 |
| 18:00 | 146 | 172 | 233 | 231 | 231 | 231 |
| 19:00 | 147 | 173 | 234 | 231 | 231 | 231 |
| 20:00 | 146 | 168 | 229 | 220 | 217 | 214 |
| 21:00 | 141 | 163 | 224 | 222 | 219 | 216 |
| 22:00 | 147 | 169 | 230 | 223 | 220 | 217 |
| 23:00 | 145 | 167 | 228 | 220 | 217 | 214 |

Table 13 lists the load data for MSG distribution transformer. The high currents were occurred at the range of 8:00 until 15:00 o'clocks, where the current values between 45 and 71 amperes.

Table 13: Load data of distribution transformer MSG

| Hours | Phase Current (A) | | | Phase Voltage (V) | | |
|-------|-------------------|-----------|-----------|-------------------|--------|--------|
| | R | S | T | R | S | T |
| 0:00 | 29 | 25 | 23 | 222.32 | 224.34 | 222.84 |
| 1:00 | 28 | 27 | 23 | 221.07 | 222.89 | 221.45 |
| 2:00 | 26 | 25 | 22 | 222.40 | 224.36 | 222.78 |
| 3:00 | 27 | 25 | 22 | 222.74 | 224.72 | 222.96 |
| 4:00 | 27 | 25 | 22 | 220.87 | 222.75 | 221.18 |
| 5:00 | 27 | 26 | 21 | 221.93 | 223.86 | 222.27 |
| 6:00 | 27 | 25 | 21 | 223.80 | 225.75 | 223.86 |
| 7:00 | 26 | 24 | 21 | 221.89 | 223.92 | 222.18 |
| 8:00 | 52 | 62 | 53 | 220.71 | 222.69 | 221.02 |
| 9:00 | 46 | 58 | 48 | 219.23 | 221.30 | 219.45 |
| 10:00 | 59 | 71 | 62 | 218.72 | 220.86 | 219.06 |
| 11:00 | 47 | 53 | 48 | 219.82 | 221.89 | 220.16 |
| 12:00 | 49 | 54 | 49 | 219.56 | 221.67 | 219.91 |
| 13:00 | 50 | 56 | 52 | 219.46 | 221.63 | 219.86 |
| 14:00 | 45 | 56 | 50 | 219.68 | 221.87 | 220.19 |
| 15:00 | 45 | 55 | 48 | 219.70 | 221.88 | 220.20 |
| 16:00 | 25 | 22 | 22 | 221.77 | 223.95 | 222.23 |
| 17:00 | 25 | 24 | 22 | 219.38 | 221.77 | 220.47 |
| 18:00 | 27 | 24 | 21 | 219.05 | 221.42 | 220.16 |
| 19:00 | 28 | 26 | 19 | 219.46 | 221.83 | 220.53 |
| 20:00 | 28 | 25 | 20 | 220.80 | 223.08 | 221.74 |
| 21:00 | 28 | 24 | 21 | 222.57 | 224.68 | 223.44 |
| 22:00 | 29 | 25 | 22 | 222.99 | 225.02 | 223.63 |
| 23:00 | 28 | 25 | 22 | 222.32 | 224.34 | 222.84 |

Table 14 lists the load data for OGA distribution transformer. The highest currents were occurred at 19:00 o'clock as 463 A, 530 A and 568 A for phase R, S and T respectively, for phase-S, phase-R and phase-T, respectively.

Table 14: Load data of distribution transformer OGA

| Time | Phase Current (A) | | | Phase Voltage (V) | | |
|-------|-------------------|------------|------------|-------------------|-----|-----|
| | R | S | T | R | S | T |
| 0:00 | 458 | 521 | 559 | 218 | 218 | 218 |
| 1:00 | 455 | 522 | 560 | 215 | 215 | 215 |
| 2:00 | 452 | 519 | 557 | 216 | 218 | 216 |
| 3:00 | 451 | 518 | 556 | 217 | 219 | 217 |
| 4:00 | 453 | 520 | 558 | 218 | 220 | 218 |
| 5:00 | 450 | 517 | 555 | 215 | 217 | 215 |
| 6:00 | 454 | 521 | 559 | 217 | 215 | 217 |
| 7:00 | 452 | 519 | 557 | 218 | 216 | 218 |
| 8:00 | 450 | 517 | 555 | 216 | 214 | 216 |
| 9:00 | 453 | 520 | 558 | 215 | 213 | 215 |
| 10:00 | 456 | 523 | 561 | 214 | 212 | 214 |
| 11:00 | 458 | 525 | 563 | 217 | 215 | 217 |
| 12:00 | 458 | 525 | 563 | 217 | 215 | 217 |
| 13:00 | 458 | 525 | 563 | 217 | 215 | 217 |
| 14:00 | 460 | 527 | 565 | 219 | 217 | 219 |
| 15:00 | 456 | 523 | 561 | 200 | 204 | 211 |
| 16:00 | 459 | 526 | 564 | 215 | 218 | 215 |
| 17:00 | 457 | 524 | 562 | 216 | 219 | 216 |
| 18:00 | 462 | 529 | 567 | 213 | 210 | 206 |
| 19:00 | 463 | 530 | 568 | 220 | 210 | 213 |
| 20:00 | 462 | 525 | 563 | 222 | 222 | 218 |
| 21:00 | 457 | 520 | 558 | 224 | 224 | 224 |
| 22:00 | 463 | 526 | 564 | 225 | 225 | 225 |
| 23:00 | 461 | 524 | 562 | 220 | 220 | 220 |

Power Loss Calculation on feeder of UZB

On the distribution transformer of ALTA, on 0:00 o'clock, the load data of low voltage side were I_{TR} and V_{TR} as 122 A and 231 V respectively. Thus, the load data of medium voltage side are shown in Table 15.

Table 15: The medium quantity parameters

| Parameter | Quantities |
|-----------|------------|
| I_{TM}' | 2.44 |
| V_{TM}' | 11 550 |
| S_{TM}' | 28.182 kVA |
| P_{TM}' | 22.5465 kW |

The distribution transformer data of ALTA were K_{transf} , $P_{Fe3phase}$ and R_{Cu} as 250 kVA, 600 watt and 0.02 Ω

respectively. Therefore, the iron loss per phase was 200 watt and the core resistance was 666,667 Ω .

The transformer copper loss at the loading $P_{Cu1phase}$ was 0.119072 watt. The transformer iron loss per phase was 200.014 watt. Therefore, the distribution transformer loss was 200.223 watt. Finally, the apparent power loss was 250.028 VA and the efficiency, based on the apparent loss, was 0.88808%.

The apparent power on the medium voltage side S_{TM} was 28.43215 kVA. While, the current on the medium voltage side I_{TM} was 2.4616 A.

The line data between PRA and ALTA were medium voltage power cable, 0.032 km and 0.14 Ω /km. Therefore, the line loss between PRA and ALTA was 0.02715 watt, or 0.0339 VA or 0.00012% of apparent power. The total loss between PRA and ALTA was 200.14615 watt or 250.18 VA.

Table 16 shows the values of power losses in the distribution transformers for feeder UZB. There were not all power losses of transformers could be calculated, because there are some distribution transformers owned by the customer or commonly called the medium voltage customers on UZB feeder.

If a transformer has medium voltage status, then the company only provide power only to the customer and can not see how much power is used on the transformer.

Table 16: Distribution transformer losses on feeder UZB in one day

| Distribution transformer | Transformer loss (kW) | Transformer capacity (kVA) | Transformer loss (%) |
|--------------------------|-----------------------|----------------------------|----------------------|
| LIKA | 15.0048 | 250 | 5.7378 |
| LIK | 23.3221 | 400 | 5.2830 |
| PRA A | 32.52431 | 630 | 4.7162 |
| PRA B | 23.27215 | 400 | 5.4818 |
| ALTA | 15.0132 | 250 | 5.8005 |
| CWI | 23.2651 | 400 | 5.2162 |
| VTX | 23.25 | 400 | 0.3812 |
| GKSI | 32.5 | 630 | 0.3158 |
| PCN | 15 | 250 | 0.3827 |
| PGG | 15.0197 | 250 | 5.4478 |
| MSG | 23.25 | 400 | 0.3812 |
| OGA | 32.6592 | 630 | 4.5184 |

To know the values of power losses based on the calculations in the feeder of UZB on any loading for one day, it can be seen in Table 17. The table shows that the total loss as 11.96 kwatt and above were occurred at the range of 16:00 until

22:00 o'clocks. This case was reasonable due to, in this time, usually it was in peak load conditions. Otherwise, the highest percentage was occurred at 5:00 o'clocks, due to in this time, it was the lowest loss.

Table 17: Calculation of losses on feeder UZB in one day

| Hours | Calculating loads (kWatt) | Calculating transformer loss (kWatt) | Calculating line loss (kWatt) | Total loss (kWatt) | Loss (%) |
|-------|---------------------------|--------------------------------------|-------------------------------|--------------------|----------|
| 0:00 | 941.4 | 10.96 | 0.95 | 11.92 | 1.27 |
| 1:00 | 929.7 | 10.96 | 0.94 | 11.90 | 1.28 |
| 2:00 | 925.7 | 10.96 | 0.94 | 11.90 | 1.29 |
| 3:00 | 926.4 | 10.96 | 0.94 | 11.90 | 1.28 |
| 4:00 | 936.8 | 10.96 | 0.95 | 11.91 | 1.27 |
| 5:00 | 913.0 | 10.96 | 0.92 | 11.89 | 1.30 |
| 6:00 | 958.2 | 10.96 | 0.97 | 11.93 | 1.24 |
| 7:00 | 954.6 | 10.96 | 0.97 | 11.93 | 1.25 |
| 8:00 | 939.1 | 10.96 | 0.95 | 11.91 | 1.27 |
| 9:00 | 949.3 | 10.96 | 0.96 | 11.92 | 1.26 |
| 10:00 | 960.3 | 10.96 | 0.97 | 11.94 | 1.24 |
| 11:00 | 966.0 | 10.96 | 0.98 | 11.94 | 1.24 |
| 12:00 | 966.0 | 10.96 | 0.98 | 11.94 | 1.24 |
| 13:00 | 964.4 | 10.96 | 0.98 | 11.94 | 1.24 |
| 14:00 | 974.9 | 10.96 | 0.99 | 11.95 | 1.23 |
| 15:00 | 930.9 | 10.96 | 0.94 | 11.91 | 1.28 |
| 16:00 | 984.8 | 10.96 | 0.996 | 11.96 | 1.21 |
| 17:00 | 992.1 | 10.96 | 1.00 | 11.97 | 1.21 |
| 18:00 | 1009.8 | 10.96 | 1.02 | 11.99 | 1.19 |
| 19:00 | 1021.6 | 10.96 | 1.03 | 11.997 | 1.17 |
| 20:00 | 1003.8 | 10.96 | 1.02 | 11.98 | 1.19 |
| 21:00 | 989.9 | 10.96 | 1.00 | 11.965 | 1.21 |
| 22:00 | 1004.2 | 10.96 | 1.02 | 11.98 | 1.19 |
| 23:00 | 966.9 | 10.96 | 0.98 | 11.94 | 1.24 |

Table 18 lists the results of loss simulation in the feeder of UZB. The total losses those higher than 12 kwatt were occurred in the ranges from 11:00 until 14:00 and from 16:00

until 23:00. Nevertheless, the latter was significantly higher than the former. This case was reasonable due to, in the latter time, it was usually peak load occurred.

Table 18: Simulation of losses on feeder UZB in one day

| Time | Simulating loads (kWatt) | Simulating transformer loss (kWatt) | Simulating line loss (kWatt) | Total loss (kWatt) | Loss (%) |
|-------|--------------------------|-------------------------------------|------------------------------|--------------------|----------|
| 0:00 | 987.4 | 11 | 1 | 12 | 1.22 |
| 1:00 | 975.4 | 10.7 | 0.9 | 11.6 | 1.19 |
| 2:00 | 970.4 | 10.7 | 0.9 | 11.6 | 1.20 |
| 3:00 | 972.4 | 10.7 | 0.9 | 11.6 | 1.19 |
| 4:00 | 981.3 | 10.9 | 1 | 11.9 | 1.21 |
| 5:00 | 957.3 | 10.3 | 0.9 | 11.2 | 1.17 |
| 6:00 | 1005.2 | 10.8 | 1 | 11.8 | 1.17 |
| 7:00 | 1000.3 | 10.8 | 1 | 11.8 | 1.18 |
| 8:00 | 984.3 | 10.5 | 1 | 11.5 | 1.17 |
| 9:00 | 994.3 | 10.5 | 1 | 11.5 | 1.16 |
| 10:00 | 1005.4 | 10.6 | 1 | 11.6 | 1.15 |
| 11:00 | 1011.3 | 11.1 | 1 | 12.1 | 1.20 |
| 12:00 | 1011.3 | 11.1 | 1 | 12.1 | 1.20 |
| 13:00 | 1009.3 | 11.1 | 1 | 12.1 | 1.20 |
| 14:00 | 1021.3 | 11.5 | 1 | 12.5 | 1.22 |
| 15:00 | 977.3 | 10.5 | 0.9 | 11.4 | 1.17 |
| 16:00 | 952.3 | 11.6 | 1 | 12.6 | 1.32 |
| 17:00 | 1040.3 | 11.5 | 1.1 | 12.6 | 1.21 |
| 18:00 | 1055.3 | 11.5 | 1.1 | 12.6 | 1.20 |
| 19:00 | 1069.3 | 12.1 | 1.1 | 13.2 | 1.23 |
| 20:00 | 1051.3 | 11.7 | 1.1 | 12.8 | 1.22 |
| 21:00 | 1037.3 | 11.2 | 1.1 | 12.3 | 1.19 |
| 22:00 | 1050.3 | 11.9 | 1.1 | 13 | 1.24 |
| 23:00 | 1013.3 | 11.4 | 1 | 12.4 | 1.22 |

Figure 4 shows the chart of load comparison between the calculation and the simulation results. Although experienced

little difference between them, both charts had similar behavior, where the peak load range was from 16:00 until 20:00.

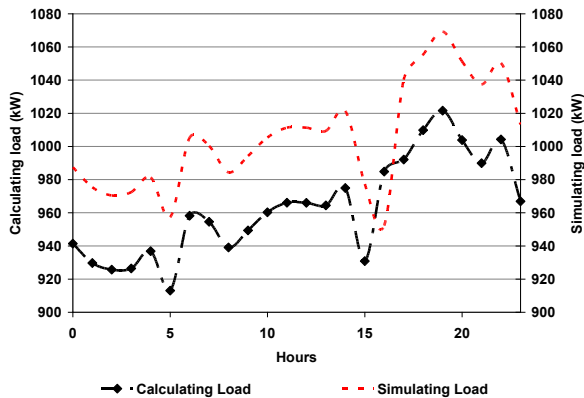


Figure 4: Load comparison charts between the calculation and simulation

Based on the chart in Figure 4, the full load was occurred at 19:00 as 1021.592 watt. Nevertheless, it is shown in the simulation, it was occurred at 19.00 as 1069.29 watt.

Figure 5 shows the chart of transformer loss comparison between the calculation and the simulation results. Although experienced very small difference between them, both charts had similar behavior, where the peak load range was from 16:00 until 20:00.

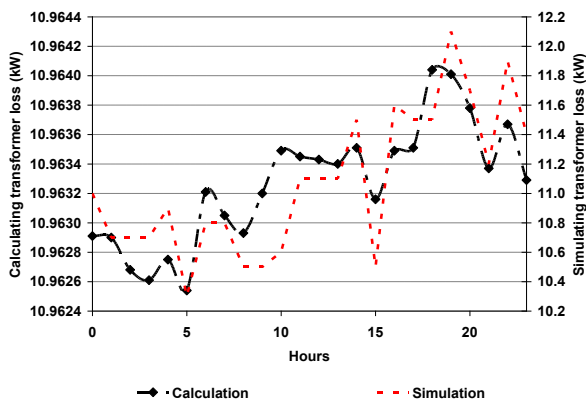


Figure 5: Transformer loss comparison charts between the calculation and simulation

From the calculation results, it was obtained by the average distribution transformer losses during the first day amounted to 10.96 kW. While the results of simulation was 11.06 kW for the same load condition. Thus, the difference between the calculation and the simulation was 0.1 kW.

Figure 6 shows the chart of line loss comparison between the calculation and the simulation results. Although experienced very small difference between them, both charts had similar

behavior, where the peak load range was from 16:00 until 21:00.

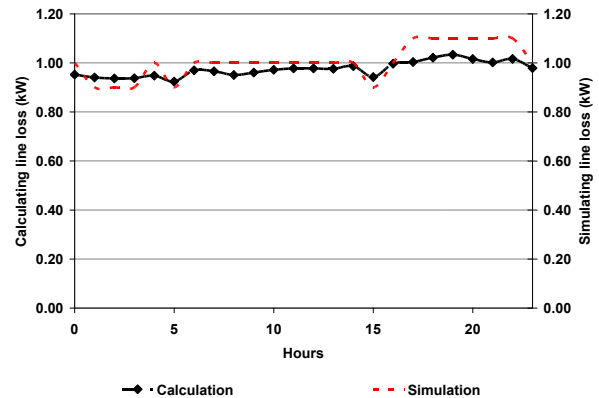


Figure 6: Line loss comparison charts between the calculation and simulation

Figure 7 shows the chart of total line loss comparison between the calculation and the simulation results. This loss consisted of both transformer loss and line loss. Although experienced very small difference between them, both charts had similar behavior, where the peak load range was from 16:00 until 21:00.

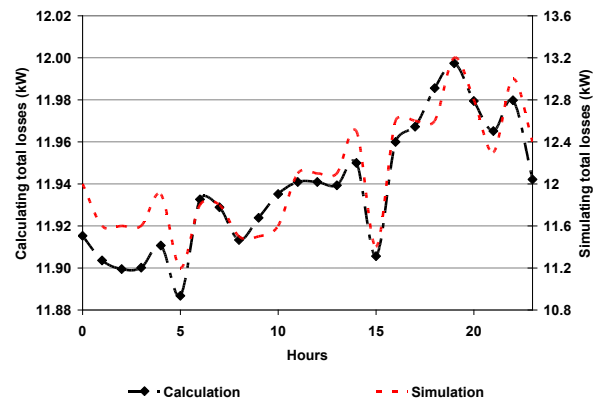


Figure 7: Total line loss comparison charts between the calculation and simulation

The line average power loss during one was 0.97 kW. While, the results of simulation for the same feeder and same load was obtained as 1 kW. Thus, the difference between the calculation and simulation results was equal to 0.03 kW.

From the tables, it is shown that the power losses in the transformers and the lines followed the shape of curve load. Thus, the greater the load, the power losses would be greater.

From the calculation results, it was obtained the average power losses, during one day, amounted to 11.93 kW. While, the results of simulation, for the case of feeders with the same load condition was obtained the yield of 12.07 kW. Thus, the

difference between the calculation and the simulation was 0.13 kW.

For the energy loss in the feeder UZB during one day was obtained by the calculation amounted to 298.42 kWh, and for one month was 8.96 MWh.

CONCLUSION

From the calculation results, it was obtained that power losses in the conductor had little value, to the line feeder UZB, which was 0.48 kW. This was caused by the used conductor of UZB feeder had the small resistance of 0.124 Ω/km, and the distance between distribution transformers was short, under 1 km.

While, the transformer power losses had considerable value, above 5% of transformer capacity. The greatest power loss was in the transformer of ALTA distribution transformer, as 5.8005% and the lowest was occurred in GKSI distribution transformer, as 0.3158%.

The maximum limit of losses to be achieved by the company was 10% for the no-load loss and + 5% for the total loss. According to the total calculation, the loss in the transformer had met the standard as 5%.

By the calculation result, it was obtained the feeder power loss for 1 day amounted to 11.93 kW. While, for same feeder and same load condition, the result of simulation was obtained as 12.07 kW. Thus, the difference between the calculation and the simulation power was 0.13 kW.

By the calculation results, it was obtained the transformer loss for 1 day amounted to 10.96 kW. While, for same feeder and same load condition, the simulation result was obtained the yield of 11.06 kW. Thus, the difference between the calculation and the simulation powers was 0.1 kW.

The line power loss during the one day was 0.97 kW. While, for same feeder and same load condition, the result of simulation was obtained as 1 kW. Thus, the difference between the calculation and the simulation was equal to 0.03 kW.

The feeder UZB energy loss during the one day was obtained by the calculation amounted to 298.42 kWh, and for one month was 8.96 MWh.

The losses contained in the line feeder of UZB were line loss and distribution loss. Furthermore, they also were identical to energy losses.

On the simulation, it could be known that the power equilibrium on the medium voltage network system, has been met. It can be seen that the source of power supply was 1003 kW and 620 kVAR, and the power on the load was 995.3 kW and 618.19 kVAR, the loss power in the transformer was 11.06 kW and 9.5 kVAR, and the loss power in the line was 1kW and - 7.8 kVAR.

A recommendation for improvement, it should be advised to do an addition of new substation with larger capacity. Furthermore, it could be changed the type of cable to be larger on the cross-sectional area of conductor. Finally, it should be advised to re-line or re-setting the distance between distribution transformers.

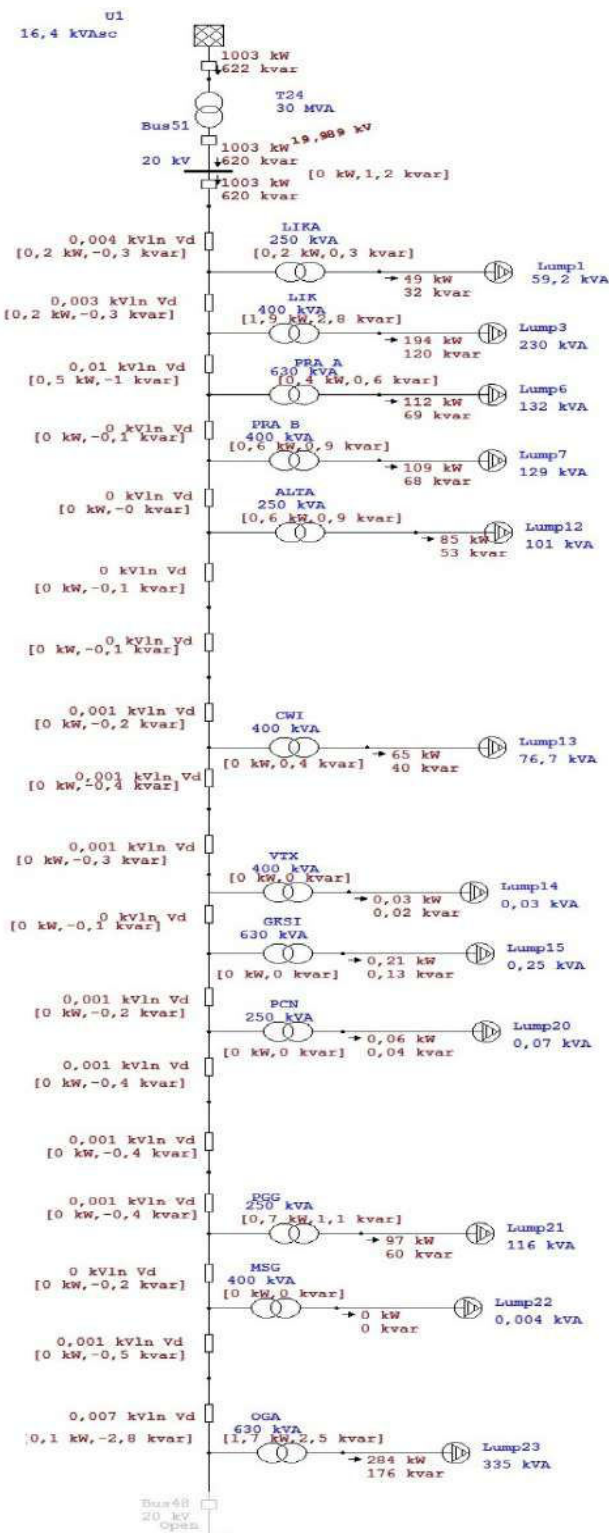


Figure 8: The load simulation results

To obtain the power loss at medium voltage distribution network more rigorous, it should be considered other loss factors, such as inductance, leakage current due to medium voltage on the line, and so forth.

ACKNOWLEDGMENTS

We would like to express the deepest appreciation to The State Electric Company APJ UB which has supported to provide the data.

REFERENCES

- [1] A.H. Al-Badi Senior Member IEEE, A. Elmoudi, I. Metwally Senior Member IEEE, A. Al-Wahaibi, H. Al-Ajmi and M. Al Bulushi, Losses Reduction In Distribution Transformers, Proceedings of the International Multi Conference of Engineers and Computer Scientists 2011, Vol. II, IMECS 2011, March 16-18, 2011, Hong Kong, ISBN: 978-988-19251-2-1, ISSN: 2078-0958(p), ISSN: 2078-0966(e).
- [2] Vafamehr, R., Design of Electrical Power Supply System in an Oil and Gas refinery, Master of Science Thesis in Electric Power Engineering, Department of Energy and Environment Division of Electric Power Engineering, Chalmers University of Technology, Göteborg, Sweden, 2011.
- [3] Yusoff, M., Busrah, A., Mohamad, M., Au, M.T., A Simplified Approach in Estimating Technical Losses in TNB Distribution Network Based on Load Profile and Feeder Characteristics, Recent Advances in Management, Marketing, Finances, ISSN: 1790-2769, ISBN: 978-960-474-168-7, pp.99-105.
- [4] Mau Teng Au¹ and Chin Hooi Tan², Energy flow models for the estimation of technical losses in distribution network, 4th International Conference on Energy and Environment 2013 (ICEE2013), IOP Publishing, pp.1-4.
- [5] Siti, MW, Nicolae, DV, Jimoh, A.A., Reconfiguration and Load Balancing in the LV and MV Distribution Networks for Optimal Performance, IEEE Transactions on Power Delivery, Volume: 22, Issue: 4, Oct. 2007)
- [6] Mahmud K., Haque, A.K.M.M., Power Scenario of Bangladesh and Schemes of Sustainable Optimal Reduction in the Power System Loss, Global Journal of Researches in Engineering, Electrical and Electronics Engineering, Vol. 12, Issue 9 Version 1.0 Year 2012, Global Journals Inc. (USA), Online ISSN: 2249-4596 & Print ISSN: 0975-5861.
- [7] Siddarameshwara, H.N., Kodad, S.F., Energy Auditing Result Analysis and Recommendations of Distribution System, ISTE-ACEEE International Journal in Electrical Engineering, Vol. 1, No. 1, Feb 2014, pp.10-14.
- [8] Bamigbola, O. M., Ali, M. M., Awodele, K.O., Predictive Models of Current, Voltage, and Power Losses on Electric Transmission Lines, Journal of Applied Mathematics, Hindawi Publishing Corporation, Volume 2014, Article ID 146937, 5 pages.
- [9] Thejovathi, K., Parveen, S.F., Babu, G.V.S., Power Loss Reduction in Radial Distribution System by Optimal Capacitor Placement to Distribution Transformer, International Journal of Scientific Engineering and Technology Research Volume.03, IssueNo.43, December-2014, ISSN 2319-8885 , pp. 8675-8682.
- [10] Adesina, L. M., Abdulkareem, A., Determination of Power System Losses in Nigerian Electricity Distribution Networks, International Journal of Engineering and Technology Volume 6 No.9, September, 2016, IJET Publications UK, pp.322-326.
- [11] Mufutau, W.O., Jokojeje, R.A., Idowu, O.A., Sodunke, M.A., Technical Power Losses Determination: Abeokuta, Ogun State, Nigeria Distribution Network as a Case Study, IOSR Journal of Electrical and Electronics Engineering (IOSR-JEEE) e-ISSN: 2278-1676,p-ISSN: 2320-3331, Volume 10, Issue 6 Ver. I (Nov-Dec. 2015), pp.1-10.
- [12] Izadi, M., Razavi, F., Hosseinian, S.H., A cost-effective analysis of the power-loss reduction methods in an actual distribution network, Elektrotehniski Vestnik, 81(4), 2014, pp.167-178.
- [13] A. Baitech, Distribution Loss Factor Calculation Methodology, Aurora Energy, July 2004.
- [14] Vegunta, S.C., Hawkins, D., Clifton, F., Steele, A., Reid, S.A., Distribution Network Losses and Reduction Opportunities from a UK DNO's Perspective, 23rd International Conference on Electricity Distribution, (CIRED 2015), Lyon, 15-18 June 2015, pp.1-5.
- [15] Kour, G., Sharma, R. K., Different Techniques of Loss Minimization in Distribution System, International Journal of Enhanced Research in Science Technology and Engineering, Vol. 2, Issue 2, Feb.2013, ISSN NO: 2319-7463, pp.1-5.
- [16] Refou, O., Alsafasfeh, Q., Alsoud, M., Evaluation of Electric Energy Losses in Southern Governorates of Jordan Distribution Electric System, International Journal of Energy Engineering, p-ISSN: 2163-1891 e-ISSN: 2163-1905, 2015; 5(2), pp.25-33.

- [17] Thakur, R., Chawla, P., High Voltage Distribution System (HVDS)-An Alternate for Improvement of Voltage Drop Profile, *International Journal of Engineering Technology, Management and Applied Sciences*, January 2015, Volume 3 Issue 1, ISSN 2349-4476, pp. 197-203.
- [18] Ajenikoko, G.A., Olaomi, A.A., A model for power losses reduction in low voltage distribution network of residential sectors, *The International Journal Of Engineering And Science (IJES)*, Vol. 3, Issue 10, 2014, ISSN (e): 2319-1813, ISSN (p): 2319-1805, pp.67-74.
- [19] Singh, G., Power Loss Reduction in Practical Distribution System, *International Journal of Electrical Engineering*, ISSN 0974-2158 Volume 5, Number 2 (2012), International Research Publication House, pp. 185-195.
- [20] Shamsudin, N.H., Omar, N.F., Sulaima, M.F., Jaafar, H.I., Kadir, A.A., The Distribution Network Reconfiguration Improved Performance of Genetic Algorithm Considering Power Losses and Voltage Profile, *International Journal of Engineering and Technology (IJET)*, Vol 6 No 2 Apr-May 2014, ISSN : 0975-4024, pp.1247-1258.
- [21] Kumar, M.K., Sairam, K.V., Santosh, R., Methods to Reduce Aggregate Technical and Commercial (At & C) Losses, *International Journal of Engineering Trends and Technology (IJETT)*-Vol.4, Issue 5, May 2013, ISSN: 2231-5381, pp.1501-1505.
- [22] Adejumbi, I.A., Adebisi, O. I., Power Loss Reduction on Primary Distribution Networks Using Tap-Changing Technique, *IJRRAS* 10 (2), Feb. 2012, pp. 272-279.
- [23] Jain, S., Singh, R., Enhancement of the Distribution System by Implementing LT- Less Distribution Technique, *International Journal of Scientific and Research Publications*, Vol. 3, Issue 10, Oct. 2013, ISSN 2250-3153, pp.1-7.
- [24] Mohsin Mahmood¹, Om Shivam², Pankaj Kumar³, Gopal Krishnan⁴, Real Time Study on Technical Losses in Distribution System, *International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering*, Vol. 3, Special Issue 1, February 2014, ISSN (Print) : 2320 – 3765, ISSN (Online): 2278 – 8875, pp. 131-137.
- [25] Suhurani, N.F.A., Analysis of Technical Losses in Distribution Line, Degree of Master of Electrical Engineering, Faculty of Electrical and Electronic Engineering, Universiti Tun Hussein Onn Malaysia, July 2014.
- [26] Pande, S., Ghodekar, J.G., Computation of Technical Power Loss of Feeders and Transformers in Distribution System using Load Factor and Load Loss Factor, *International Journal of Multidisciplinary Sciences and Engineering*, Vol. 3, No. 6, June 2012, ISSN:2045-7057, pp. 22-25.
- [27] Bamigbola, O. M., Ali, M. M., Awodele, K. O., Predictive Models of Current, Voltage, and Power Losses on Electric Transmission Lines, *Journal of Applied Mathematics*, Vol. 2014 (2014), Article ID 146937, 5 pages.
- [28] Siti, M.W., Nicolae, D.V., Jimoh, A.A., Ukil, A., Reconfiguration and Load Balancing in the LV and MV Distribution Networks for Optimal Performance, *IEEE Transactions on Power Delivery*, Vol. 22, Issue 4, Oct. 2007, pp.2534-2540.
- [29] Khan, M.A., Badshah, S., Haq, I.U., Hussain, F., Measures for reducing transmission and distribution losses of Pakistan, *International Journal of Scientific & Engineering Research*, Volume 4, Issue 4, April 2013 ISSN 2229-5518, pp.616-619.
- [30] Vasile, P.G., Mircea, C., Radu, B., Octavian, G.C., Daniel, G., Răzvan, V., Reducing Losses in Electrical Distribution Systems Using Amorphous Transformers, *Journal of Sustainable Energy*, Vol. 1, No. 4, December, 2010, pp. 71-76.
- [31] Asawin Rajakrom, Undergrounding the Power Distribution Network in Luang Prabang World Heritage, *MSG ARN International Journal* 5 (2011), pp.37-44.
- [32] Abdou, A.A., Kamel, S., Eid, A., Voltage Stability Improvement of an Egyptian New City Electrical Network Using Static VAR Compensator, *International Journal on Power Engineering and Energy (IJPEE)* Vol.8, No.1, January 2017, ISSN 2314-7318(p), 2314-730X(p), pp.708-713.
- [33] Chembe, D. K., Reduction of Power Losses Using Phase Load Balancing Method in Power Networks, *Proceedings of the World Congress on Engineering and Computer Science 2009 Vol I, WCECS 2009*, October 20-22, 2009, San Francisco, USA.
- [34] Lakshmanan, E., Kumaresan, M., Analysis of Technical Power Losses by Supervisory Control and Data Acquisition Load Flow Techniques, *International Journal of Control Theory and Applications (IJCTA)*, 9(4), 2016, International Science Press, pp. 1855-1867.
- [35] Thakur, R., Chawla, P., Voltage Drop Calculations and Design of Urban Distribution Feeders, *IJRET: International Journal of Research in Engineering and Technology*, eISSN: 2319-1163, pISSN: 2321-7308, Vol.: 04 Special Issue: 12, NCIDCEME-2015 | Oct-

- 2015, pp.43-53.
- [36] Baghipour, R., S.M. Hosseini, A Hybrid Algorithm for Optimal Location and Sizing of Capacitors in the presence of Different Load Models in Distribution Network, *Journal of Operation and Automation in Power Engineering*, Vol. 2, No. 1, Winter & Spring 2014, pp.10-21.
- [37] Sanjay A. Deokar, Laxman M. Waghmare, Analysis of Distribution Transformer Performance under Non-linear Balanced Load Conditions and Its Remedial Measures, *International Journal of Emerging Technology and Advanced Engineering*, ISSN 2250-2459, Vol. 1, Issue 2, December 2011, pp.152-161.
- [38] Boroujeni, S. T., Mardaneh, M., Hashemi, Z., A Dynamic and Heuristic Phase Balancing Method for LV Feeders, *Applied Computational Intelligence and So Computing*, Volume 2016, Article ID 6928080, Hindawi Publishing Corporation, 8 pages.
- [39] Catelani, M., Ciani, L., Fossi, A., Giorgi, A., Battistone, A., D'Adamo, C., Fioriti, G., Modeling of outages occurrence in medium voltage power lines, *AEIT International Annual Conference (AEIT)*, 2015, 14-16 Oct. 2015.
- [40] Santos, A.C., Romero, S.C., Garcia, A.E., Molina, C.P., Simplified Analysis of the Electric Power Losses for On-Shore Wind Farms Considering Weibull Distribution Parameters, *energies*, 2014, 7, ISSN 1996-1073, pp.6856-6885.
- [41] Ingmar Leibe, Integration of Wind Power in Medium Voltage Networks, Voltage Control and Losses, Division of Industrial Electrical Engineering and Automation Faculty of Engineering, Licentiate Thesis, Department of Measurement Technology and Industrial Electrical Engineering, Lund University, 2011.
- [42] Minimizing Energy Losses: Optimal Accommodation and Smart Operation of Renewable Distributed Generation, *IEEE Transactions on Power Systems*, Vol. 26, Issue: 1, Feb. 2011, pp.198-205.
- [43] Tamizharasi, P., Anuradha, R., Ayshwarya, A.R, Analysis of Distribution Transformer Losses in Feeder Circuit, *International Journal of Innovative Research in Advanced Engineering (IJIRAE)*, Vol. 1, Issue 1 (March 2014), ISSN: 2278-2311, pp.1-6.
- [44] Ahmad, A., Akbari, A., Iqbal, J., GIS-Based Identification of Overload Distribution Transformer and Calculation of Technical Electric Power Losses, *International Journal of Civil Engineering and Geo-Environmental* 6 (2015), ISSN: 21802742, pp. 14-21.
- [45] V. A. Kulkarni and P. K Katti, Estimation of Distribution Transformer Losses in Feeder Circuit, *International Journal of Computer and Electrical Engineering*, Vol. 3, No. 5, October 2011, PP. 659-662.
- [46] Shibata, E., Energy Saving by Reducing No Load Loss of Distribution Transformers, the 23rd Energy System, Economy and Environment Conference January 25-26, 2007.
- [47] Olivares, J.C., Liu, Y., Cañedo, J. M., -Pérez, R.E., Driesen, J., Moreno, P., Reducing Losses in Distribution Transformers, *IEEE Transactions on Power Delivery*, Vol. 18, No. 3, July 2003, pp.821-826.
- [48] Radu Godina 1, Eduardo M. G. Rodrigues 1, João C. O. Matias 1 and João P. S. Catalão 1,2,3, Effect of Loads and Other Key Factors on Oil-Transformer Ageing: Sustainability Benefits and Challenges, *Energies* 2015, 8, ISSN 1996-1073, 12147-12186.
- [49] Is_Ik, F., Glu, Y.U., Amorphous core transformers efficiency analysis in Turkish electrical distribution systems, *Turkish Journal of Electrical Engineering & Computer Sciences*, (2015) 23: pp.1523-1535.
- [50] Harden, K. D., Optimizing Energy Efficiency Standards for Low Voltage Distribution Transformers, Thesis, Master of Science in Engineering, Purdue University, Fort Wayne, Indiana May 2011.
- [51] Ghadai, J., Das, C., Failure of Transformers due to Harmonic Loads, *International Journal of Electrical, Electronics and Mechanical Controls*, ISSN (Online) : 2319-7501, Volume 3 Issue 3 September 2014, pp.1-12.
- [52] Ozerdem, O.C., Al-Barrawi, A., Biricik, S., Measurement and Comparison Analysis of Harmonic Losses in Three Phase Transformers, *International Journal on "Technical and Physical Problems of Engineering" (IJTPE)*, March 2013, Issue 14, Volume 5, Number 1, pp. 114-118.
- [53] Jan, S. T., Afzal, R., Khan, A. Z., Transformer Failures, Causes and Impact, *International Conference Data Mining, Civil and Mechanical Engineering (ICDMCME'2015)* Feb. 1-2, 2015 Bali (Indonesia), pp.49-52.
- [54] Alias, L., Malathi, V., Methods for Reduction of Stray Loss in High Current LV Regions of Large Power Transformers Using FEM Analysis, *International Journal of Research in Science and Technology, (IJRST)* 2015, Vol. No. 5, Issue No. III, Jul-Sep e-ISSN: 2249-0604; p-ISSN:2454-180X, pp.40-52.
- [55] Farooq, A., Naveed, N., Simulink Modeling of Three Windings Linear Transformer as A Power Distribution Network, *Sci.Int. (Lahore)*, 27(5), Sept.-Oct. 2015 ISSN 1013-5316; CODEN: SINTE 8, pp. 4101-4104.

- [56] Digalovski, M., Najdenkoski, K., Rafajlovski, G., Prediction of Core Losses of Three-Phase Distribution Transformer, *Journal of Energy and Power Engineering* 7 (2013), David Publishing, pp.2347-2353.
- [57] Dapke, S., Thosar, A.G., Shaha, S.S., Designing of Amorphous Core Distribution Transformer and Comparison with CRGO Core Distribution Transformer, *International Journal Of Modern Engineering Research (IJMER)*, Vol. 5, Iss. 6, June 2015, IJMER | ISSN: 2249-6645, pp.1-5.
- [58] Man Mohan, An Overview on Amorphous Core Transformers, *Journal of Emerging Trends in Engineering and Applied Sciences (JETEAS)* 3 (2): 217-220, © Scholarlink Research Institute Journals, 2012 (ISSN: 2141-7016), pp. 217-220.
- [59] Peter, G.P., A Review about Testing of Distribution Transformers, *International Journal of Advancements in Technology (IJoAT)*, Vol 2, No 1 (January 2011), ISSN 0976-4860, pp. 165-177.
- [60] Irianto, C.G., Setiabudy, R., Hudaya, C., Design of Delta Primary - Transposed zigzag Secondary (DTz) Transformer to Minimize Harmonic Currents on the Three-phase Electric Power Distribution System, *International Journal on Electrical Engineering and Informatics - Volume 2, Number 4, 2010*, pp. 278-290.
- [61] Godina, R., Rodrigues, E.M.G., Matias, J.C.O., Catalão, J.P.S., Effect of Loads and Other Key Factors on Oil-Transformer Ageing: Sustainability Benefits and Challenges, *Energies* 2015, 8, ISSN 1996-1073, pp.12147-12186.
- [62] Shrivastava, N., Sameena, Mubeen, E., Evaluation of Energy Efficient Core Material of Distribution Transformer, *International Journal of Electrical and Electronics Research* ISSN 2348-6988 (online) Vol. 3, Issue 1, Month: January-March 2015, pp.113-117.
- [63] Hassan, R.U., Shami, U.T., Safdar, A., Evaluation of Losses and Life of Distribution Transformer under Non-linear Load using Wavelet Transform, *Proceedings of the Pakistan Academy of Sciences: A. Physical and Computational Sciences* 53 (3): (2016), ISSN: 2518-4245 (print), 2518-4253 (online), Pakistan Academy of Sciences, pp.309-317.
- [64] Sah, R.M., Srivastava, J., Modelling And Simulation Of Distribution Transformer For Analysing The Transformer Losses Using Analytical And Simulation Method, *International Journal of Engineering Research and Applications (IJERA)* ISSN: 2248-9622, Vol. 3, Issue 3, May-Jun 2013, pp.984-987.
- [65] Yendhe R.S, Jape V.S, Design of Energy efficient switchable distribution transformer and its compact remote monitoring system, *SSRG International Journal of Electrical and Electronics Engineering (SSRG-IJEEE)* – volume 2 Issue 5 May 2015, ISSN: 2348 – 8379, pp. 22-28.
- [66] Sharma, R., Sharma, S., Control of Power Distribution Losses through Good Quality Distribution Transformers, *International Journal of Engineering and Innovative Technology (IJEIT)* Volume 2, Issue 11, May 2013, ISSN: 2277-3754, pp. 192-195.
- [67] Kostinskiya, S.S., Troitskiy, A.I., Functional Dependence for Calculation of Additional Real-power Losses in a Double-wound Supply Transformer Caused by Unbalanced Active Inductive Load in a Star Connection with an Insulated Neutral, *International Journal of Environmental and Science Education*, 2016, Vol. 11, No. 15, pp.7975-7989.
- [68] Gupta, A., Soni, A., The Performance Analysis of Distribution Transformer under Domestic Harmonics Load, *International Journal of Innovative Research in Electrical, Electronics, Instrumentation and Control Engineering*, Vol. 4, Special Issue 4, November 2016, ISSN (Online) 2278-1021, ISSN (Print) 2319-5940, pp. 4-8.
- [69] Ghosh, S., Calculation of Hot Spot Temperature and Aging of A Transformer, *International Journal of Technical Research and Applications*, e-ISSN: 2320-8163, Vol. 4, Issue 1, Jan.-Feb., 2016, pp. 140-143.
- [70] Galvan, J.C.O., Perez, R.E., Maximov, S., Adame, S.M., Georgilakis, P.S., Cost reduction by interchanging the location of the windings in distribution transformers with HV copper winding and LV aluminum winding, *International Transactions on Electrical Energy Systems*, *Int. Trans. Electr. Energ. Syst.* (2014), pp.1-11.
- [71] Asrami, M.Y., Mirzaie, M., Akmal, A.S., Gholamian, S.A., Life Estimation of Distribution Transformers Under Non-Linear Loads Using Calculated Loss by 2D-FEM, *Journal of Electrical Systems*, 7-1 (2011), pp.12-24.
- [72] Pandav Sharoniben .J1, Parmar Jaydipsinh .K2, Analysis of Amorphous Metal Core Distribution Transformer, *International Journal of Science and Research (IJSR)* Volume 5 Issue 5, May 2016, ISSN (Online): 2319-7064, pp.88-91.
- [73] Kaur, G., Gupta, N., Design of Thermoelectric Cooler Transducer based Transformer Heat Exchanger System, *International Journal of Current Engineering and Technology*, Vol.5, No.5 (Oct 2015), E-ISSN 2277 – 4106, P-ISSN 2347 – 5161, pp. 3411-3414.
- [74] Manmohan, Distribution Transformer with Circular

Section of Amorphous Core, International Journal of Scientific Engineering and Technology, Volume No.1, Issue No.3, 01 July 2012, ISSN: 2277-1581, pp.67-71.

- [75] Srinivasan, M., Krishnan, A., Prediction of Transformer Insulation Life with an Effect of Environmental Variables, International Journal of Computer Applications (0975 – 8887) Volume 55– No.5, October 2012, pp. 43-48.
- [76] Tong, L., Research on Intelligent Online Monitoring and Evaluation of Power Transformer, The Open Electrical & Electronic Engineering Journal, 2015, 9, pp.483-489.
- [77] Majeed, I. B., Eduful, G., Normanyo, E., Determination of Optimum Number of Unit Transformers for High Voltage Distribution System, International Journal of Engineering Research and Technology (IJERT), IJERTV4IS050642, Vol. 4 Issue 05, May-2015, ISSN: 2278-0181, pp. 607-609.