Welcome to AsiaPES 2008

Selamat Datang (Welcome) to the 2008 IASTED International Conference on Asia Power and Energy Systems (AsiaPES 2008) in Langkawi, Malaysia.

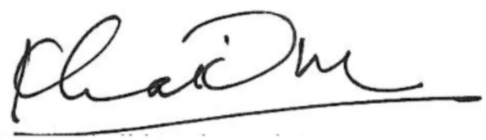
AsiaPES 2008 has attracted excellent contributions: authors from 40 countries have submitted 190 papers. On behalf of the conference, I thank all authors who have made a great effort to contribute to the conference. After a thorough and rigorous review process by members of the AsiaPES 2008 International Program Committee (IPC), 70 top quality papers have been registered for presentation at the conference. On behalf of IASTED I thank all reviewers who have taken the time to review the submitted papers. Without the strong and unstinting support of the reviewers the high quality program of AsiaPES 2008 would not be possible.

In addition to the delegates, the conference is especially delighted to welcome our keynote speaker and our tutorial presenter. The AsiaPES 2008 Keynote Speaker is Prof. San Shing Choi, of the Nanyang Technological University, Singapore, The title of his address is, "*Distributed Generation and the Role of Energy Storage Systems.*" The AsiaPES 2008 tutorial will be presented by Mr. Sazali P. Abdul Karim, of the Transmission Division of the Tenaga Nasional Berhad (TNB), the dominant electric utility company in Malaysia. Mr. Sazali will present a tutorial on *"Fault Analysis in Transmission System."*

This conference will provide an excellent opportunity for engineering and technology professionals, researchers, academics and students, coming from more than 20 countries and from every continent on the globe, to gather and meet for mutual benefits. Delegates will learn from high quality presentations, discuss innovative ideas, update on current interests and be exposed to the best practices on various topics of power and energy systems.

Apart from enjoying a technically beneficial and fruitful conference, I pray that you will enjoy your stay in Langkawi and will have some time to visit various sites of interest, both historical and aesthetic, on this lovely island and in other parts of Malaysia.

Prof. Khalid Mohamed Nor
Chair, IASTED ASIAPES 2008 Conference



Proceedings of the Fourth IASTED Asian Conference on **Power and Energy Systems**, held April 2 – 4 in Langkawi, Malaysia.

SPONSORS
The International Association of Science and Technology for Development (IASTED)
- Technical Committee on Power and Energy Systems

EDITOR
K.M. Nor – Universiti Teknologi Malaysia, Malaysia

KEYNOTE SPEAKER
S.S. Choi – Nanyang Technological University, Singapore

TUTORIAL PRESENTER
S.P. Abdul Karim – TMB Transmission Division, Malaysia

INTERNATIONAL PROGRAM COMMITTEE

ADDITIONAL REVIEWERS

INFORMATION ON PUBLICATION
For each IASTED conference, the following review process is used to ensure the highest level of academic content. Each full manuscript submission is double blind reviewed by a minimum of two separate reviewers on the International Program Committee/Additional Reviewers list. The review results are then compiled. If there are conflicting reviews, the paper is sent to a third reviewer.

Photo Credits: Background © Christian Wagner; title banner © Martin Hurry

ACTA Press
P.O. Box 5124
Anaheim, CA 92814–5124
USA

ACTA Press
B6, Suite #101, 2509 Dieppe Ave SW
Calgary, Alberta T3E 7J9
Canada

ACTA Press
P.O. Box 354
CH–8053 Zurich
Switzerland

Publication Code: 606

[Conferences] [Membership] [Publications] [FAQ] [Contact Us] [Search] [Home]

TABLE OF CONTENTS
AsiaPES 2008

Langkawi, Malaysia
April 2 to 4, 2008

Welcome Note

Distribution Systems

Electromagnetic Field Analysis

606-182
Influence of Soil Characteristics on the Impedance of Aboveground and Buried Wires in Multilayer Horizontal Soil Model Environments
H. Zhao, S. Fortin, and F.P. Dawalibi (Canada)

606-115
Potential and Electric Field Profiles for Transmission Line Insulators
S. Reddy B and U. Kumar (India)

606-186
GMR of Stranded Multizone Conductors
Y. Yang, S. Fortin, J. Ma, and F.P. Dawalibi (Canada)

606-020
Comparison between the Localized Power Loss and Flux Distribution in a Three Phase Distribution Transformer 100 kVA Assembled from Various Type of T-Joint Geometry with Staggered Yoke
I. Daut, D.M.M. Ahmad, and S. Taib (Malaysia)

606-144
Measurement of Flux Distribution on 100kVA 3Phase Distribution Transformer Assembled with 45° T-Joint and Mitred Lap Corner Joint with Stagger Yoke by using Search Coil
I. Daut, D.M.M. Ahmad, and S. Taib (Malaysia)

Proceedings of the Fourth IASTED International Conference
POWER AND ENERGY SYSTEMS (AsiaPES 2008)
April 2-4, 2008 Langkawi, Malaysia
ISBN CD: 978-0-88986-732-1

MEASUREMENT OF FLUX DISTRIBUTION ON 100KVA 3PHASE DISTRIBUTION TRANSFORMER ASSEMBLED WITH 45^{O} T-JOINT AND MITRED LAP CORNER JOINT WITH STAGGER YOKE BY USING SEARCH COIL

I. Daut, Dina M.M. Ahmad, and S. Taib
School of Electrical System Engineering, Universiti Malaysia Perlis (UniMAP),
P.O Box 77, d/a Pejabat Pos Besar
01007 Kangar Perlis, Malaysia
Email: ismail.daut@kukum.edu.my, dina@kukum.edu.my, soibtaib@eng.usm.my

ABSTRACT
This paper describes the result of measurement of flux distribution on 100kVA 3phase distribution transformer assembled with 45° T-joint and mitred lap CORNER joint with stagger yoke. The measurement involves the variation of flux. The flux distributions have been measured using no load test by arrays of search coil in M5 (CGO) grades material of transformer core laminations. The localised flux density at the outer 45° T-joint is 90 mT and rises to be 148 mT at the inner 45° T-joint and the localised flux density at the outer corner-joint is 103 mT and rises to be 198 mT at the inner corner-joint when the transformer core energized 1 T 50Hz. A small amount of flux deviation from the rolling direction occurs at the overlap.

KEY WORDS
Flux distribution, transformer core, search coil

1. Introduction

Transformer iron loss can be reduced either by improving the quality of the steel or by using better building and design techniques. The efficiency of a transformer core is also largely dependent upon the design of the joints at the junctions of the yoke and limbs. In these regions the flux may deviate from the rolling direction of the steel or become distorted so that local areas of the high loss are produced. [1]

The objective of this investigation is to know the flux distribution of the transformer core built from electrical steel (M5) with 3% silicon iron assembled with 45° T-joint and mitred lap corner joint with stagger yoke by using search coil

2. Experimental Apparatus and Measuring Technique

A 3-phase,3 limb stacked cores are assembled with 45° T-joint and mitred lap corner joints as indicated in Figure 1. The core is 550 mm x 580 mm with the limbs and yokes 100 mm wide. The core is assembled from 0.3 mm thick laminations of M5 grain-oriented silicon iron (CGO) as indicated in Figure 2 and the core comprises of 15 layers has staggered yoke of core with overlap length of 5 mm from other adjacent lamination. Staggering alternate layers of laminations in the yoke direction as indicated in figure 2 is known to reduce the losses of core assembled from silicon iron [2]

Flux distribution in the Cold Rolled Grain Oriented (CRGO) is measured by using an array of search coils to get the satisfactory result. In this investigation an array of single turn search coil is employed to measure in-plane (longitudinal and transverse) of flux density in the lamination within the transformer core.
The locations chosen must cover the areas where the flux is more likely to vary direction so as to find distribution of the flux behavior as shown in Figure 3 and 4.

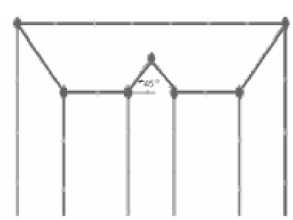


Figure 1. Transformer core type with T-joint 45°

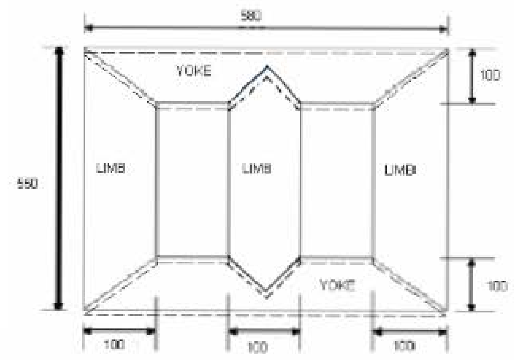


Figure 2. Dimension (mm) of 100kVA transformer model

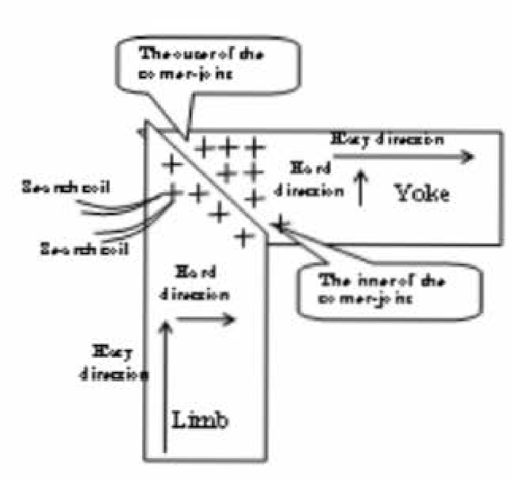


Figure 3. The position of easy and hard direction in the corner joint of transformer core

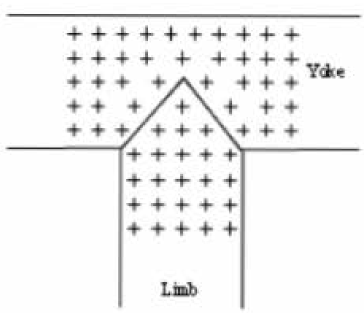


Figure 4. The search coil position in the T-joint of transformer core

The testing process is done by using the No-Load Test Frame. The No-Load Test Frame consisting of three windings for each three phase core are designed in order not only to avoid introducing stress to the laminations but also to keep the magnetism exactly constant in all limbs of the cores as indicated in figure 5. The core could be energized to 1.5 T (50Hz)

The magnitude and direction with reference to the x axis of the in-plane instantaneous flux density can be written in the form [3]:

$$|b| = \frac{1}{4fNAn}[\bar{e}_x^{\,2} + \bar{e}_y^{\,2}]^{1/2} \tag{1}$$

and

$$\alpha = \tan^{-1}\left(\frac{e_y}{e_x}\right) \tag{2}$$

where

f = frequency supply
N = Number of transformer winding
A = Cross section area of transformer core lamination that measured
n = number of layer of transformer core lamination
e_x = maximum value of the component of induced emf in the easy direction
e_y = maximum value of the component of induced emf in the hard direction

Sample calculation as follow:

From transformer frame are obtain number of turn is 254 turns, area of lamination is 0.000003m^2 with number of layer is 15 layers and frequency supply is 50 Hz. When the supply adjusted to transformer at 1.5T so at the search coil will find the induced emf by oscilloscope measurements at easy direction is 190mV and hard direction is 180mV. By using the equation (1) will find the flux density at this point is 103mT.

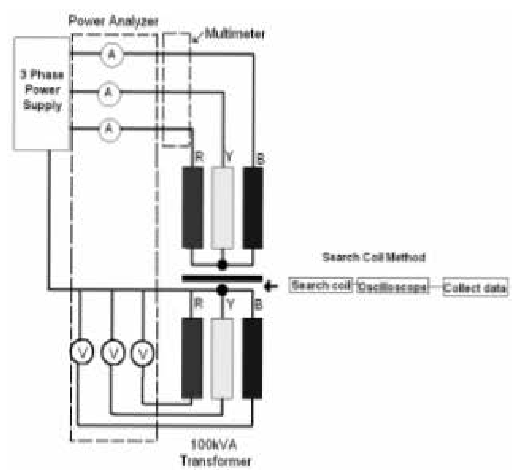


Figure 5. The diagram of the methods that used to measure the localised flux density

3 Result and discussion

Figure 6 shows the mesh graph of the localised flux density measured by using the search coil at the 45° T-joint of transformer core lamination. This mesh graph is drawn by using the Matlab software based on the result of this investigation. The flux density at 45° T-joint causes the flux density in lamination yoke drop in the 45° T-joint and flux transfers into the laminations above and below it.

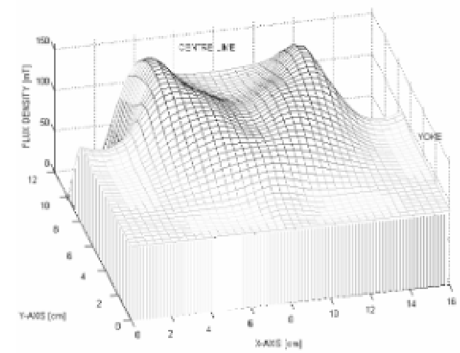


Figure 6. The mesh graph of the localised flux density measured by the search coil at the 45° T-joint

The flux density in the limb then drops rapidly as the flux distributes itself equally between the laminations. The flux density reaches a peak at the inner of 45° T-joint; this is caused by the saturated material. The minimum flux density occurs at the outer of 45° T-joint of transformer core lamination. The localised flux density will increase from the outer to the inner of the 45° T-joint. The localised flux density at the outer 45° T-joint is 90 mT and rises to be 148 mT at the inner 45° T-joint when the transformer core energized 1.5 T 50Hz.

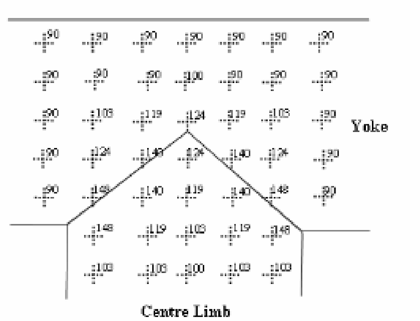


Figure 7. The average flux density at 45° T-joint (the values are expressed in mT) is measured by using search coil

Figure 7 shows the measuring point of location and localized flux densities at 45° T-joint that are measured by using the search coil on transformer core. This result is produced by calculating localized flux density after the search coil measures the vector of the voltage in the easy and hard direction at the lamination.

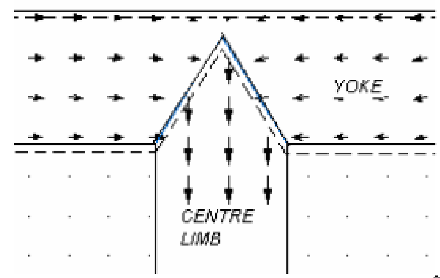


Figure 8. Distribution of localized flux density at 45° T-joint

Figure 8 shows the variation in magnitude and direction of flux density at 45° T-joint. A small amount of flux deviation from the rolling direction occurs at the overlap.

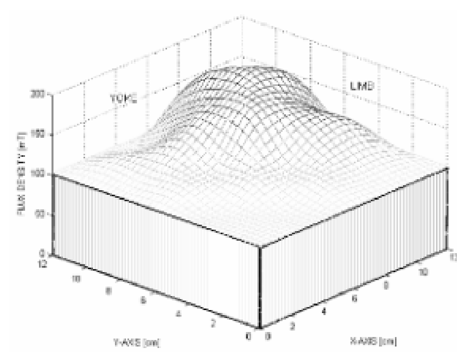


Figure 9. The mesh graph of the localised flux density measured by the search coil at the corner-joint

Figure 9 shows the mesh graph of the localised flux density measured by using the search coil at the Corner-joint of transformer core lamination. This mesh graph is drawn by using the Matlab software based on the result of the investigation. The flux density at corner joint causes the flux density in lamination yoke drop in the corner joint and flux transfers in to the laminations above and below it. The flux density in the limb then drops rapidly as the flux distributes itself equally between the laminations. The flux density reaches a peak at the inner of corner joint; this is caused by the saturated material. The minimum flux density occurs at the outer of corner-joint of transformer core lamination. The localised flux density will increase from the outer to the inner of the corner-joint. The localised flux density at the outer corner-joint is 103 mT and rises to be 198 mT at the inner corner-joint when the transformer core energized 1.5 T 50Hz.

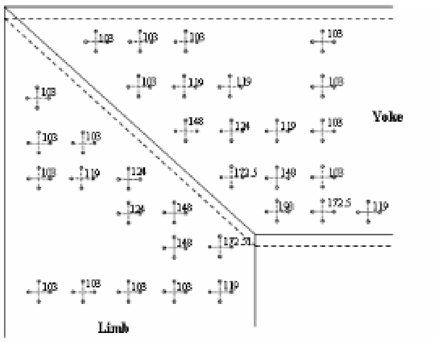


Figure 10. The average flux density at corner joint (the values are expressed in mT) is measured by using search coil

Figure 10 shows the measuring point of location and localized flux densities at corner-joint that are measured by using the search coil on transformer core. This result is produced by calculating localized flux density after the search coil measures the vector of the voltage in the easy and hard direction at the lamination

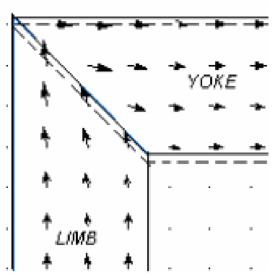


Figure 11. Distribution of localized flux density at corner joint

Figure 11 shows the variation in magnitude and direction of flux density at corner joint. A small amount of flux deviation from the rolling direction occurs at the overlap, but no rotational flux is present in the joint. The major regions where the flux deviates from the rolling direction are the corners where the flux passes from the yoke to the limbs.

4. Conclusion

The flux distribution in cores assembled with M5 materials varies with the stagger length. The localised flux density will increase from the outer to the inner of the 45° T-joint. The localised flux density at the outer 45° T-joint is 90 mT and rises to be 148 mT at the inner 45° T-joint when the transformer core energized 1.5 T 50Hz.
The localised flux density will increase from the outer to the inner of the corner-joint. The localised flux density at the outer corner-joint is 103 mT and rises to be 198 mT at the inner corner-joint when the transformer core energized 1.5 T 50Hz.

A small amount of flux deviation from the rolling direction occurs at the overlap, but no rotational flux is present in the joint. The reason for the higher loss in the 45 degree T-joint and the mitred lap joint is due to the presence of rotational flux

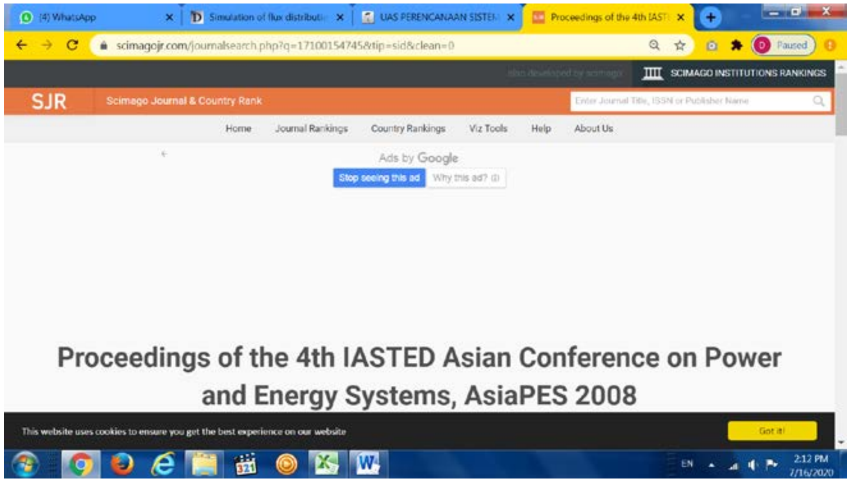
Acknowledgements

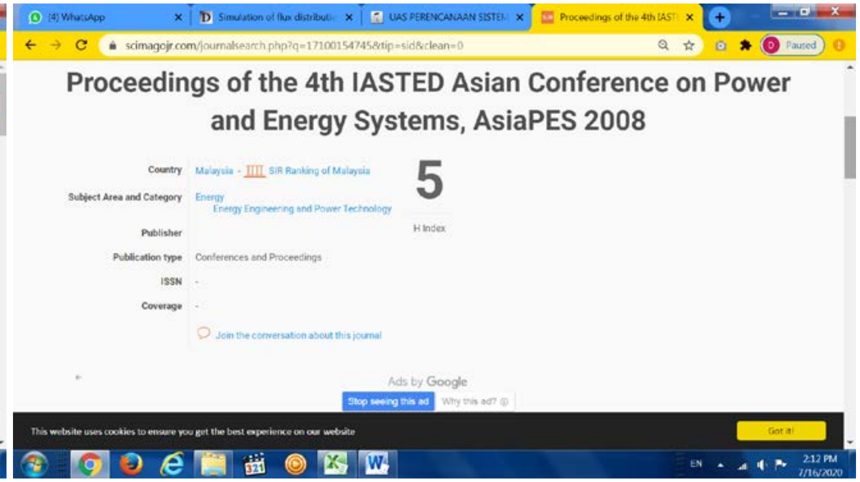
The authors thank the MTM Company for the material given to the authors for the purpose of the investigation in completing this paper

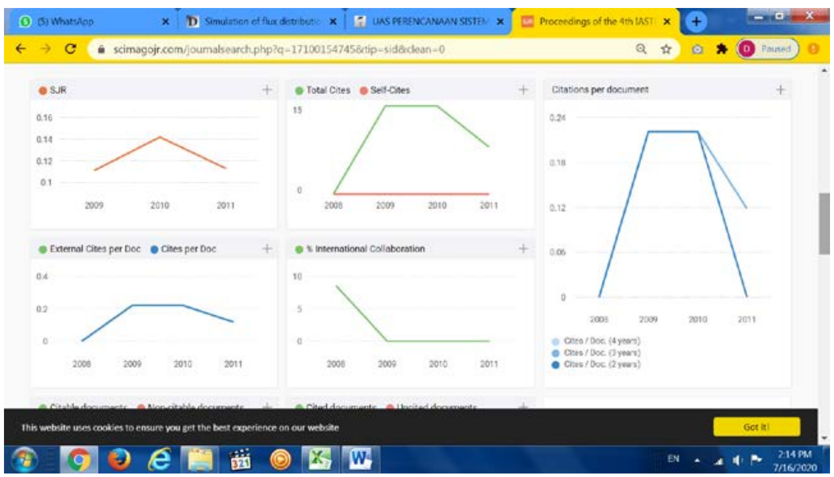
References

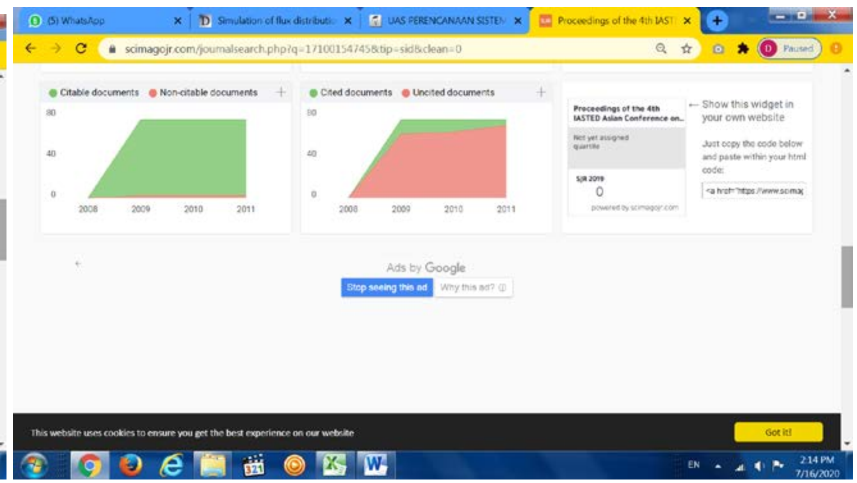
[1] Jones, A. J., Moses, A. J., Comparison of the Localized Power Loss and Flux Distribution in the Butt and Lap and Mitred Overlap Corner Configurations, *IEEE Tans. ON MAG., VOL. MAG-10*, No. 2, june 1974.
[2] Daut, I and Moses, A.J., Some Effects Of Core Building On Localised Losses And Flux Distribution In A Three-Phase Transformer Core Assembled From Powercore Strip, *IEEE Trans. On Mag., Vol. MAG-26*, No 5, pp. 2002, Sept 1990
[3] Daut, I.,"*Investigation of Flux and Loss Distribution in Transformer Cores Assembled From Amorphous Powercore Material*", 1992, PhD Thesis University of Wales
[4] Beckley P., *Electrical Steels for rotating machines*, The Institution of Electrical Engineers, 2002.
[5] Indrajit Dasgupta, *Design of Transformers Handbook*, Tata Mc- Graw Hill, India, 2002.
[6] James H. Harlow, *Electric Power Transformer Engineering*, CRC Press LLC, 2004.

https://www.scimagojr.com/journalsearch.php?q=17100154745&tip=sid&clean=0

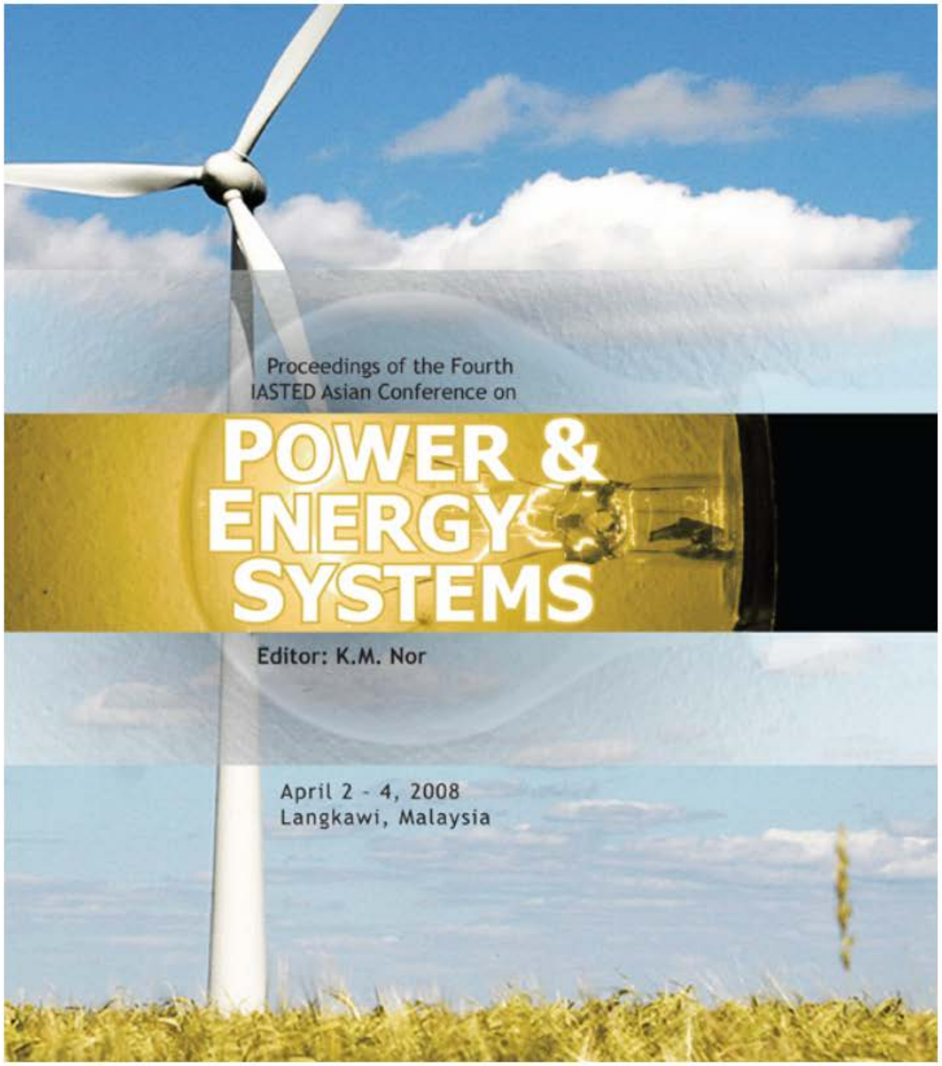








Web: https://www.iasted.org/conferences/pastinfo-606.html



Anaheim | Calgary | Zurich

IASTED