PowerTech 2009

28 June - 2 July 2009, Bucharest, Romania

- Innovative ideas toward the Electrical Grid of the Future -

University POLITEHNICA of Bucharest

National Power Grid Company TRANSELECTRICA S.A.

Home

Invitation

On behalf of the International Steering Committee and the Local Organizing Committee we invite you to attend the IEEE BPT2009. The Bucharest PowerTech Conference continues the tradition of the Power Tech Conferences held in odd years in Athens, Stockholm, Budapest, Porto, Bologna, St. Petersburg and Lausanne.
PowerTech is the anchor conference of the IEEE Power & Energy Society in Europe It is intended to provide a forum for scientists and engineers interested in electric power engineering to share ideas, results of their scientific work, to learn from each other as well as to establish new friendships and rekindle existing ones.
The PowerTech Conference provides a bridge between generations. The interest from enthusiastic young practicing engineers and PhD students wishing to publish their work increased from event to event. The most valuable IEEE student work is recompensated with the Basil Papadias award, which has been also an important ingredient toward the event's success.

The event is sponsored by the IEEE Power & Energy Society and will be organized by University POLITEHNICA of Bucharest, National Power Grid Company TRANSELECTRICA S.A. and IEEE PES Romania Chapter.

IEEE Bucharest PowerTech Conference

28 June – 2 July, 2009

Provisional[*)]

Technical Program

[*)] Some sessions may shorten in case of non-registration

Session: **Transmission system costs and pricing**
Chair:
Room: **"Nicolae Balcescu" Hall – NB**
Time: **Thursday, July 2, 14.00 – 15.45**

49 **Evolution Of The Marginal Based Remuneration of the Portuguese Transmission Company From 1998 To 2004**
Joao Tome Saraiva (Universidade do Porto and INESC, Portugal), Helder Fernando Dantas

63 **Impact of Load and Generation Price Uncertainties in Spot Prices**
Bruno A. Gomes (Universidade do Porto and INESC, Portugal), Joao T. Saraiva (Universidade do Porto and INESC, Portugal), Luis M. Neves (Instituto Politécnico de Leiria, Portugal)

449 **Electricity and CO_2 Emissions System Prices Modeling and Optimization**
Steffen Rebennack (University of Florida, USA), Niko A. Iliadis (EnerCoRD, Greece), Mario V.F. Pereira (PSR, Centro Empresarial Rio, Brazil), Panos M. Pardalos (University of Florida, USA)

578 **Modelling of Prices Using the Volume in the Norwegian Regulating Power Market**
Stefan Jaehnert (Norwegian University of Science and Technology, Norway), Hossein Farahmand (Norwegian University of Science and Technology, Norway), Gerard Doorman (Norwegian University of Science and Technology, Norway)

580 **Usage Based Allocation for Transmission Costs under Open Access**
L.G. Mănescu (University of Craiova, Romania), D. Ruşinaru (University of Craiova, Romania), Paul Dădulescu (Romanian TSO – Transelectrica SA., Romania), Valeria Anghelina (Romanian TSO – Transelectrica SA., Romania)

623 **Forecasting Electricity Prices in Spot Markets – One Week Horizon Approach**
Andre F. Duarte (Efacec Engenharia S.A., Portugal), Jose N. Fidalgo (Universidade do Porto, Portugal), Joao T. Saraiva (Universidade do Porto, Portugal)

685 **Transmission Loss Allocation of Bilateral Contracts Using Load Flow Permutations Average Method**
Vahid Rasouli Disfani (Department of Electricity Market Monitoring, Iran), Farzad Razavi (Tafresh University, Iran), Babak Kashanizadeh (Department of Electricity Market Monitoring, Iran), Shayan Dargahi (Amirkabir University of Technology, Iran)

Transmission Loss Allocation of Bilateral Contracts Using Load Flow Permutations Average Method

Vahid Rasouli Disfani, Farzad Razavi, Babak Kashanizadeh, and Shayan Dargahi

***Abstract*--In a deregulated power system, bilateral contracts between suppliers and buyers are allowed and transmission loss due to their power transactions should be allocated firmly. In this paper, we introduce "Load Flow Permutations Average Method" (LFPAM), a novel application of Shapely Value method, to assess the transmission loss allocation of bilateral contracts in an electricity market. This method, in which the load flow technique is carried out in an iterative process, lists all possible permutations of the contracts in load flow analysis and runs shapely value technique in order to evaluate the shares of each bilateral contracts of transmission losses. In the other words, after calculating the all contracts' shares of transmission loss in each permutation, the average of the results determines a firm transmission loss allocation of bilateral contracts. Finally, the method has been presented along with some numerical examples to put emphasis on its accuracy and fairness.**

***Index Terms*—Bilateral Contracts, Electricity Market, Game Theory, Permutation, Shapely Value, Transmission Loss Allocation**

I. INTRODUCTION

Competition in power industries is the most important issue that motivates the power systems to replace the traditional vertically integrated structure by a deregulated one. Moreover, since flow of power should be transmitted from generators to loads through transmission lines, the transmission loss is a natural phenomenon in a power system. Therefore, in a deregulated power system, the transmission loss is a continuous issue as it related to a huge amount of money and should be attributed to the power system participants. It is obvious that both sides of bilateral contracts are responsible for compensation of the transmission losses corresponding to their power transaction. Then, suppliers and buyers share the losses allocated to themselves depending on their contract.

A number of works on transmission loss allocation have been recently reported in literature. In the Pro-Rata (PR) technique [1] that ignores the system configuration, losses are globally allocated to producers and customers through a proportional allocation rule. PR is used in mainland Spain to assess the transmission loss allocation. In [2, 3] Z-Bus loss allocation method introduces a loss expression in terms of the Z-bus matrix and injection of current instead of power injection. This method separates the transmission loses among the system buses. In marginal procedures [4], losses are allocated to generators and demands using incremental transmission loss coefficients.

Furthermore, Proportional Sharing Methods [5-8] uses a linear proportional sharing principle plus the results of a power flow process in order to calculate transmission loss allocation. "This principle states that the power flow reaching a bus from any power line splits among the lines evacuating power from the bus proportionally to their corresponding power flows, which is neither provable nor disprovable" [1].

Another method based on unbundling of branch flows has been presented in [9]. To use this method which is modified incremental loss factor method and is applicable on a nodal basis, four methods have been proposed for splitting branch flows. Marginal Transmission Loss Allocation (MTLA) [10] is another method based on Kron's transmission loss expression and results in an iterative process. Incremental Load Flow Approach (ILFA) [10, 11] use modified load flow calculation to assess the transmission loss allocation. In ILFA, contracted load is increased in a discrete step at each load bus while the other contracted loads at other buses kept constant. The resulted differential loss is allocated to the corresponding bilateral contract. In this method, the loads are increased from zero to their respective levels, in alternative sequence and discrete steps to allocate the transmission losses fairly.

However, game theoretic methods are also viable to fairly allocate transmission power losses beside the methods mentioned before. For example, Shapely value, the τ-value, and the average lexicographic value are the most applicable one-point solution concepts for pay-off allocation in cooperative game theory [12]. Of these three methods, Shapely value seems fairer as all contributions of all participants are mentioned; so, it is widely used to compute shares of each participant of a coalition with no discrimination [13].

Since transmission loss allocation of bilateral contracts is a

V. R. Disfani is with Department of Electricity Market Monitoring, Tehran, Iran (e-mail: vrdisfani@alum.sharif.edu).

F. Razavi is with the Department of Electrical Engineering, Tafresh University, Tafresh, Iran (e-mail: razavi.farzad@taut.ac.ir).

B. Kashanizadeh is with Department of Electricity Market Monitoring, Tehran, Iran (e-mail: b.kashanizadeh@gmail.com).

Sh. Dargahi is now student of the Department of Electrical Engineering, Amirkabir University of Technology, Tehran, Iran (e-mail: dargahi123@yahoo.com).