ISSN 1974-9821
Vol. 2 N. 4
August 2009

International Review on Modelling and Simulations (IREMOS)

Contents:

(continued on outside back cover)

PWP
Praise Worthy Prize

Copyright © 2009 Praise Worthy Prize S.r.l. - All rights reserved

International Review on Modelling and Simulations (IREMOS)

Editor-in-Chief:

Santolo Meo
Department of Electrical Engineering
FEDERICO II University
21 Claudio - I80125 Naples, Italy
santolo@unina.it

Editorial Board:

Marios Angelides	(U.K.)	Brunel University
M. El Hachemi Benbouzid	(France)	Univ. of Western Brittany- Electrical Engineering Department
Debes Bhattacharyya	(New Zealand)	Univ. of Auckland – Department of Mechanical Engineering
Stjepan Bogdan	(Croatia)	Univ. of Zagreb - Faculty of Electrical Engineering and Computing
Cecati Carlo	(Italy)	Univ. of L'Aquila - Department of Electrical and Information Engineering
Ibrahim Dincer	(Canada)	Univ. of Ontario Institute of Technology
Giuseppe Gentile	(Italy)	FEDERICO II Univ., Naples - Dept. of Electrical Engineering
Wilhelm Hasselbring	(Germany)	Univ. of Kiel
Ivan Ivanov	(Bulgaria)	Technical Univ. of Sofia - Electrical Power Department
Jiin-Yuh Jang	(Taiwan)	National Cheng-Kung Univ. - Department of Mechanical Engineering
Heuy-Dong Kim	(Korea)	Andong National Univ. - School of Mechanical Engineering
Marta Kurutz	(Hungary)	Technical Univ. of Budapest
Baoding Liu	(China)	Tsinghua Univ. - Department of Mathematical Sciences
Pascal Lorenz	(France)	Univ. de Haute Alsace IUT de Colmar
Santolo Meo	(Italy)	FEDERICO II Univ., Naples - Dept. of Electrical Engineering
Josua P. Meyer	(South Africa)	Univ. of Pretoria - Dept.of Mechanical & Aeronautical Engineering
Bijan Mohammadi	(France)	Institut de Mathématiques et de Modélisation de Montpellier
Pradipta Kumar Panigrahi	(India)	Indian Institute of Technology, Kanpur - Mechanical Engineering
Adrian Traian Pleşca	(Romania)	"Gh. Asachi" Technical University of Iasi
Ľubomír Šooš	(Slovak Republic)	Slovak Univ. of Technology - Faculty of Mechanical Engineering
Lazarus Tenek	(Greece)	Aristotle Univ. of Thessaloniki
Lixin Tian	(China)	Jiangsu Univ. - Department of Mathematics
Yoshihiro Tomita	(Japan)	Kobe Univ. - Division of Mechanical Engineering
George Tsatsaronis	(Germany)	Technische Univ. Berlin - Institute for Energy Engineering
Ahmed F. Zobaa	(U.K.)	Univ. of Exeter - Camborne School of Mines

The ***International Review on Modelling and Simulations (IREMOS)*** is a publication of the **Praise Worthy Prize S.r.l.**.
The Review is published bimonthly, appearing on the last day of February, April, June, August, October, December.
Published and Printed in Italy by **Praise Worthy Prize S.r.l.,** Naples, August 31, 2009.

Copyright © 2009 Praise Worthy Prize S.r.l. - All rights reserved.

This journal and the individual contributions contained in it are protected under copyright by **Praise Worthy Prize S.r.l.** and the following terms and conditions apply to their use:
Single photocopies of single articles may be made for personal use as allowed by national copyright laws.
Permission of the Publisher and payment of a fee is required for all other photocopying, including multiple or systematic copying, copying for advertising or promotional purposes, resale and all forms of document delivery. Permission may be sought directly from **Praise Worthy Prize S.r.l.** at the e-mail address:
administration@praiseworthyprize.com

Permission of the Publisher is required to store or use electronically any material contained in this journal, including any article or part of an article. Except as outlined above, no part of this publication may be reproduced, stored in a retrieval system or transmitted in any form or by any means, electronic, mechanical, photocopying, recording or otherwise, without prior written permission of the Publisher. E-mail address permission request:
administration@praiseworthyprize.com

Responsibility for the contents rests upon the authors and not upon the **Praise Worthy Prize S.r.l.**.
Statement and opinions expressed in the articles and communications are those of the individual contributors and not the statements and opinions of **Praise Worthy Prize S.r.l.**. **Praise Worthy Prize S.r.l.** assumes no responsibility or liability for any damage or injury to persons or property arising out of the use of any materials, instructions, methods or ideas contained herein.
Praise Worthy Prize S.r.l. expressly disclaims any implied warranties of merchantability or fitness for a particular purpose. If expert assistance is required, the service of a competent professional person should be sought.

Praise Worthy Prize

International Review on Modelling and Simulations (I.RE.MO.S.), Vol. 2, N. 4
August 2009

Evaluation of Distribution Reliability Improvement with Distributed Generators Using Monte Carlo Simulation

Fangxing Li[1], Nura Sabir[2]

Abstract – *This paper models the impact of distributed generation to distribution system reliability using a comprehensive, sequential Monte Carlo simulation model. Since utility-connected distributed generation is typically installed close to the consumers, it can reduce the current at the main feeder. Consequently, it increases the chance that a stressed feeder can be reconfigured under a fault at a neighboring feeder. As a comparison, it may be impossible to reconfigure feeder connection because reconfiguration will lead to line overflow without distributed generators to supply part of the load. Test results from a system modified from the IEEE 34-bus system are presented. It is shown that installation of distributed generators can improve the distribution system reliability considerably.* ***Copyright © 2009 Praise Worthy Prize S.r.l. - All rights reserved.***

***Keywords**: Distributed Generation, Distribution Reliability, Monte Carlo Simulation, Reconfiguration*

E - P R I N T

I. Introduction

Distribution system reliability is an important measure of utility performance. In order to quantify the reliability of the distribution system metrics known as reliability indices are used. The indices are statistical collections of reliability data, they are used as way to assess the effectiveness the distribution system to supply power to the customer continually [1]-[10]. Reliability indices can be placed in two categories, local indices or load point indices, and global or system indices. Load point indices measure the impact to the individual customer, while the system indices measure the overall reliability of the system [2]-[4]. This paper focuses on the system indices mainly from the utilities' viewpoint. Despite many different reliability indices, a survey [5] shows that there are four most popular ones, System Average Interruption Frequency Index (SAIFI), System Average Interruption Duration Index (SAIDI), Customer Average Interruption Duration Index (CAIDI), and Average Service Availability Index (ASAI). The definition of these indices can be found in many literatures such as [1]-[10] and briefly reviewed below.

SAIFI indicates how often an average customer experiences an interruption for a specific amount of time. The formula for SAIFI is:

$$SAIFI = \frac{\sum Total\ Number\ of\ Customer\ Interrupted}{Total\ Number\ of\ Customers\ Served} \quad (1)$$

SAIDI indicates the time-span of the interruption for the average customer during a specified amount of time. The formula for SAIDI is:

$$SAIDI = \frac{\sum Customer\ Interrupted\ Duration}{Total\ Number\ of\ Customers\ Served} \quad (2)$$

However, CAIDI and ASAI can be obtained from SAIFI and SAIDI, as shown below:

$$CAIDI = \frac{SAIDI}{SAIFI} \quad (3)$$

$$ASAI = \frac{8760 - SAIDI}{8760} \quad (4)$$

Therefore, this paper will focus on the discussion of SAIFI and SAIDI since CAIFI and ASAI can be derived easily from SAIFI and SAIDI. On the other hand, there is an increasing interest to install distributed generators (DGs) in the system due to economic and technical considerations [11]-[12]. Typically the DG units are gas turbines powered by synchronous generators, wind powered induction generators, fuel cells, hydro, and photovoltaic. They offer various applications as well various benefits such as backup generation, peak shaving, net metering, voltage support, energy-loss reduction, release of system capacity and improvement in reliability [13]-[20]. This research seeks to explore how distributed generation will affect reliability. The models of reliability impact evaluation in these previous works either were based on average reliability data or considered a subset of all possible uncertain parameters.

Manuscript received and revised July 2009, accepted August 2009
Copyright © 2009 Praise Worthy Prize S.r.l. - All rights reserved

However, this work presents a comprehensive sequential Monte Carlo simulation model to address line capacity limit, time-varying load, and distributed generation.

This paper is organized as follows: Section II presents the basic algorithm to perform the distribution reliability evaluation with Monte Carlo simulation (MCS); Section III presents the detailed comprehensive MCS simulation model considering line capacity limit, time-varying load and the distributed generation. Section IV presents a test based on a system modified from the IEEE 34-bus distribution test system. Section V presents conclusions, and Section VI provides some discussions about possible future works.

II. Basic Model for Monte Carlo Simulation for Distribution Reliability

Reliability assessment for distribution system can be based on analytical simulation or Monte Carlo simulation (MCS). The former is for the average case (or year if the during of one year is considered) based on average component failure rate and average repair/switch time. Hence, it gives the mean value of reliability indices like SAIFI and SAIDI. As a comparison, MCS first creates an artificial, random operational history which is also based on the average component failure rate and average repair/switch time. However, since it generates an artificial history, variation of different cases (bad years, average years, or good years) will all presented in the sample years of MCS, with different probability. Hence, it gives a probability distribution of reliability indices, from which the mean value and the standard deviation can be obtained. It should be noted that although Monte Carlo simulation may be performed non-sequentially via some simplification [8], this work focuses on sequentially MCS due to its strong modeling capability.

In this section, first, the component model is discussed. Second, the artificial random failure and repair history of all components are presented. Third, the impact to customer interruption is presented. Here, the reconfiguration is considered. However, the capacity limit of distribution feeders is not considered in this Section.

E-PRINT

II.1. Component Reliability Model

The reliability-related parameters that describe the characteristics of each component need to capture all requirements critical to the systems reliability while remaining as simple as possible. The two parameters that are used in this model are the failure rate (λ) and mean time to repair (MTTR). There is another parameter called mean time to switch (MTTS), which is not addressed here since we consider the future distribution system will be highly automated and this automatic switching will significantly reduced the interruption time such that it will not be classified as a sustained interruption. Therefore, it does not affect SAIFI and SAIDI, which are two indices related to sustained interruption. In addition, the focus of this paper is to compare the reliability indices with or without DGs. It is reasonable to have this assumption, which is applied to both cases (with and without DG).

II.2. Artificial Component Operation History

A critical requirement in sequential Monte Carlo simulation is to create the artificial history of faults for each component. It is the applied to identify the occurrence of contingencies and its impact to power supply. The artificial history is a two-state model, either the component is energized and in the up state or it is de-energized and in the down state. The up state is referred to as the time to failure (TTF) and the down state is referred to as the time to repair (TTR) or time-to-switch (TTS). Since here we assume switching is automatic and instantaneous, so only TTF and TTR is considered. The transition between the two states is referred to as the failure process [3]-[4]. As previously mentioned this process is random therefore there is a need to use random variables. Random values are generated between 0 and 1 to calculate TTF and TTR for each component.

$$TTF_i = -\frac{ln(U_i)}{\lambda_i} \times 8760 \quad hours \tag{5}$$

$$TTR_i = -ln(U_i) \times MTTR_i \quad hours \tag{6}$$

where λ_i =failure rate (1/yr)
$MTTR_i$=mean time to repair (hour).

Fig. 1 shows the typical up down operating history of components.

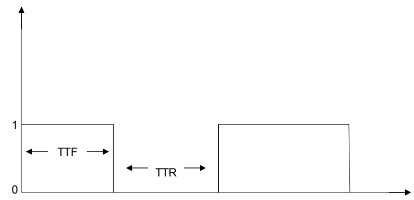

Fig. 1. Component up down operating history

It should be noted that multiple, overlapping failures at different component may occur, although very rarely. This work considers this case and the impact of multiple, overlapping component failures will be considered jointly. For instance, if the system is already experiencing a fault and the duration time is predicted to be four hours and then another fault is predicted with a duration time of seven hours when the system has already been down for three hours, then duration time is extended by seven additional hours, instead of becoming operational after one more hour, the system will be down for a total of 8 hours. This is an advantage of MCS compared to the analytical simulation for an average case, which typically consider a single component failure

Copyright © 2009 Praise Worthy Prize S.r.l. - All rights reserved

once a time, and then accumulate the impact from each individual component failure. Thus, analytical simulation does not consider possible overlap of component failure duration.

II.3. Customer Interruption Due to a Component Failure

When a component fails due to a sustained fault (as assumed here for illustrative purpose), a portion of the system will be out of service and the customers will experience an interruption. Assume the failed component, C, has a repair time of TTR_C. The typical process is described as follows:

a. Fault isolation: An upstream search is performed to find the nearest protection or reclosing device, P, which operates to isolate the fault.
b. Upstream isolation: If there is at least one switching device between P and C, the one closest to C will be opened to isolate the faulted component. Since we assume all switches including this one, S, is automatic, no sustained interruption will be experienced at customers between P and S. Although they will experience momentary interruptions, this paper addresses the indices related to sustained interruption (SAIFI and SAIDI), which are more popularly adopted.
c. Downstream restoration through reconfiguration: If there is an alternate power source through a normally open switch (NOS) and there is another normally closed switch (NCS) between NOS and C, all components between two switches will not experience a (sustained) interruption due to the assumption of automatic switching for reconfiguration.
d. All isolated and un-restored components (including load points) experience a sustained interruption of TTR_C.

In the above steps, upstream searching and downstream searching are needed. Details of the searching algorithm are implemented based on the algorithms described in [1].

The above process is applied to every hour. In continuous hours, if there system state is the same (such as the same component is out of service), then the above process does not need to be repeated. The previous hour results will be simply used. In other words, the above process needs to be performed only if the system state changes such as a fault occurs after the normal state or the repair is done after the fault.

II.4. Monte Carlo Simulation Procedure Considering Reconfiguration

The generic process of Monte Carlo simulation can be briefly described as follows:

1. Start with the first sample year.
2. An artificial, hourly history of faults is generated, as shown in Section 2.2.
3. Starting at time zero (first hour), identify location of the faults.
4. Apply the steps in Section 2.3 to identify the interrupted customers.
5. Return to Step 2 until each hour in a year has been analyzed.
6. Perform an accounting to obtain the total interrupted customer-times and total interrupted customer-hours. Then, SAIFI and SAIDI can be calculated for this sample year.
7. Return to Step 1 until pre-determined stopping criteria is met, typically after a predefined number of iterations such as 5000 times.
8. Aggregate calculated reliability indices to produce probability distribution.
9. Repeat Steps 2-11 for the following sample year till reaching a pre-determined number of sample years.

III. Comprehensive Model Of Monte Carlo Simulation

The downstream restoration through reconfiguration has been an effective approach to minimize the impact of component failure and to improve system reliability. However, this is an increasing concern about whether the reconfiguration will lead to line overload or not, especially in developing areas with more stressed distribution feeders. With a decreasing line capacity margin, sometimes reconfiguration may not be possible if reconfiguration may cause the line flow violating the capacity limit. Therefore, a check of line capacity needs to be performed in the simulation before the reconfiguration is performed. Then, the check of line capacity calls the need of the actual chronological load model to assist with the line capacity check.

With distributed generators embedded in the feeders, it will reduce the line flow in general, since it can back feed a portion of the load from the customer side. This will make reconfiguration more possible, especially under the stressed feeders or the peak load hours.

With these factors considered, the step C in Section 2.2 should be modified to include an additional step to check whether the line flow (if reconfigured) will violate the line capacity limit or not. Certainly, the actual model should be a line flow calculation. However, a full line flow for each hourly simulation in MCS will be too costly in terms of computational time. Therefore, a simplified load flow is used. Basically, the losses will be ignored. And, the line flow will be a topological search to accumulate all loads. The accumulated load of the main feeder (after pre-assumed reconfiguration) will be used to verify whether the line flow limit will be violated or not. Since line losses are typically 5-10% in distribution feeders, this should not have a significant impact to the result accuracy. Again, the main focus of this paper is to look at the difference of reliability for two cases: with DG or without DG. Then, any assumption

E-PRINT

E - P R I N T

equally applied to both cases should not affect much of result accuracy. With the above details, the proposed model becomes a comprehensive, sequential Monte Carlo simulation model that address line capacity limit, time-varying load, and distributed generation, which makes this work different from the previous works.

IV. Test Results

Fig. 2 shows the test system that was modeled. IEEE 34-bus distribution system was duplicated and tied together using a normally open switch. This configuration allows for each individual system to serve as a backup source if needed, which would potentially improve reliability. This is a typical configuration for many urban distribution systems. Also, each feeder has a recloser around the mid-point such that it can isolate the fault to smaller area. The line reliability data is created based on typically component reliability data given in [1]. The test system is sufficiently small to permit the execution of reliability calculations with reasonable computation time but attempts to have enough detail to represent a practical system. The system supplies different combinations of time varying loads. The test system has 16 load points and each load point has a different load curve with an associated peak load value and average load value. Load profiles vary from hour to hour, from day to day, from year to year, and from season to season. In addition to the load curve that is assigned to each load point there is a certain amount of customers that are assigned. Since this data is not provided in the test system, the number of customers at each load point is calculated based on the average value at the load point divided by a presumed 8kVA for each customer. The load curves at each load point that were used for in this work are shown in Fig. 3. And the peak load and average load at all load points are shown in Table I. Each system has a total of two 1MVA, automatically controlled distributed generators each connected by a normally open switch. The results are shown in Figs. 4-7. It is clearly shown that the installation of DG can reduce the reliability indices by 20%, which is:

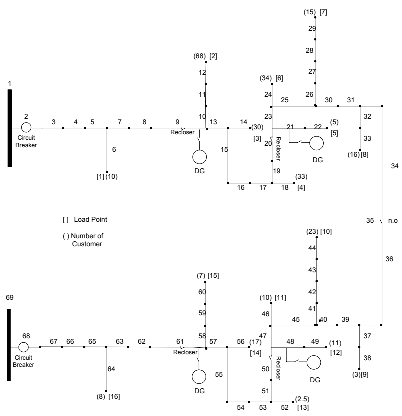

Fig. 2. Test System Modified from the IEEE 34-node Test System

TABLE I
Peak Value, Average Value, And Number Of Customers Of Each Load Point

Load Point	Peak Load (kVA)	Average Load (kVA)	Number of Customers
1	145.7	81.02	10
2	893	543.97	68
3	505	242.61	30
4	569	260.33	33
5	72.85	40.51	5
6	446.5	271.98	34
7	252.5	121.31	15
8	284.5	130.17	16
9	48.57	27.01	3
10	297.67	181.32	23
11	168.33	80.87	10
12	189.67	86.78	11
13	36.43	20.26	3
14	223.25	135.99	17
15	126.25	60.65	7
16	142.25	65.08	8

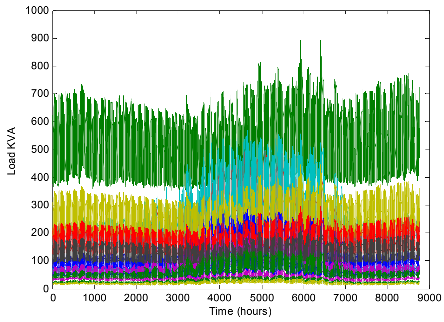

Fig. 3. Load Curves for 16 Load Points on Test System

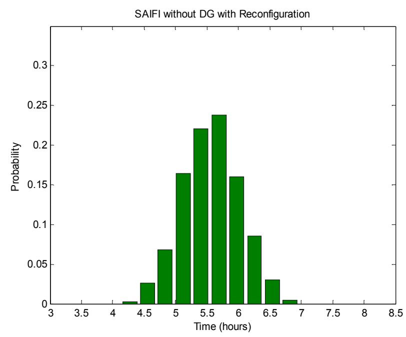

Fig. 4. Probability distribution of SAIFI for the case without DG

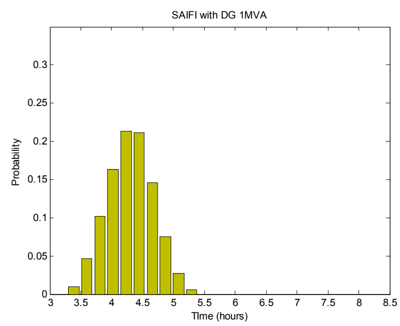

Fig. 5. Probability distribution of SAIFI for the case with DG

Copyright © 2009 Praise Worthy Prize S.r.l. - All rights reserved

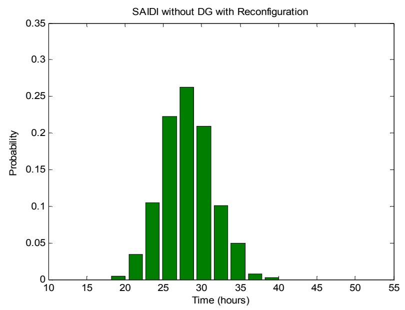

Fig. 6. Probability distribution of SAIDI for the case without DG

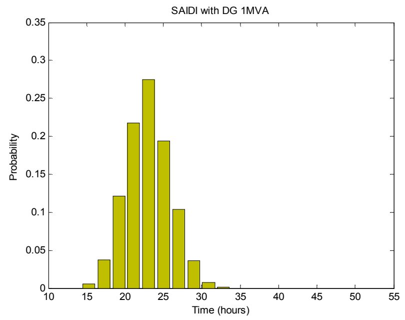

Fig. 7. Probability distribution of SAIDI for the case with DG

E-PRINT

V. Conclusion

This work models the impact of distributed generation to distribution system reliability. Since utility-connected distributed generation is typically installed close to the consumers, it can reduce the current at the main feeder. Consequently, it increases the chance that a stressed feeder can be reconfigured under a fault at a neighboring feeder. As a comparison, it may be impossible to reconfigure feeder connection because reconfiguration will lead to line overflow without distributed generators to supply part of the load.

The reliability assessment in this work is carried out with a comprehensive sequential Monte Carlo simulation. The factors considered include time-varying load model, reconfiguration possibility check with a simplified load flow, the impact of DG in improving the reliability since more reconfiguration is possible because of DG's back feed capability. This comprehensive, sequential Monte Carlo simulation can give the probabilistic distribution of SAIFI and SAIDI based on a large sample of random failures of system components.

Test results from a test system modified from the IEEE 34-bus system are presented based on the analytical approach and the Monte Carlo simulation. It is shown that installation of distributed generators can improve the distribution system reliability considerably.

VI. Future Work

Future work may lie in a deeper analysis of impact of reliability with different size of DGs at different locations. Further, when different types of DGs are considered, the results may be different. For instance, the photovoltaics have an output patterns affected by sun light, and the distributed wind generators have an output patterns greatly affected by the wind. Hence, the time of possible component failure will have an impact on whether reconfiguration with DG is possible or not.

Another important extension of this work is to identify possible approaches to identify the optimal location of DGs considering reliability measures. If we consider system reliability indices, perhaps with a weighted average of multiple indices like SAIFI and SAIDI, as the objective function to minimize, this will be non-linear and non-continuous optimization problem with respect to DG size and location. If some heuristic rules such as sensitivity of SAIFI and SAIDI with DG sizes and location can be identified from research works similar to this one, it can significantly simplify the optimization model. Therefore, it will be easier to combine the reliability measures as part of a multi-objective optimization considering reliability, power losses, environmental impact, and so on. Lastly, as utilities customers' usage of sensitive electronics increase, the slightest disruption of power may have catastrophic affects. Therefore, it will be beneficial to study what role momentary interruption plays in the overall reliability of the system.

References

[1] R. E. Brown, *Electric Power Distribution Reliability*, 2002.
[2] R. Billinton and R.N. Allan, *Reliability Evaluation of Power Systems*, 2nd edition, Plenum Press, New York, 1996.
[3] R. Billinton and P. Wang, "Teaching Distribution System Reliability Evaluation Using Monte Carlo Simulation," *IEEE Trans. on Power Systems*, Vol. 14, No. 2, pp. 397-403, May 1999.
[4] Wang, P. and R. Billinton, "Time Sequential Distribution System Reliability Worth Analysis Considering Time Varying Load and Cost Models," *IEEE Transactions on Power Delivery*, Vol. 14, No. 3, pp. 1046-1051, July 1999.
[5] IEEE/PES Working Group on System Design, "A survey of distribution reliability measurement practices in the US," *IEEE Trans. on Power Delivery*, Vol. 14, No.1, pp250-257, January 1995.
[6] R. E. Brown and J.R. Ochoa, "Distribution System Reliability: Default Data and Model Validation," *IEEE Trans. on Power System*, Vol. 13, No. 2, pp. 704-709, May 1998.
[7] R. E. Brown and J. J. Burke, "Managing the Risk of Performance Based Rates," *IEEE Trans. on Power Systems*, Vol. 15, No. 2, pp. 893-898, May 2000.
[8] Fangxing Li, Richard E. Brown, and Lavelle A.A. Freeman, "A Linear Contribution Factor Model and its Applications in Monte Carlo Simulation and Sensitivity Analysis," *IEEE Trans. on Power Systems*, Vol. 18, No. 3, pp. 1213-1215, Aug. 2003.
[9] N. Balijepalli, S.S. Venkata, and R.D. Christie, "Modeling and Analysis of Distribution Reliability Indices," *IEEE Trans. on Power Delivery*, Vol. 19, No. 4, pp. 1950-1955, Oct. 2004.
[10] Fangxing Li, "Distributed Processing for Reliability Assessment and Reliability-Based Network Reconfiguration with Simulated Annealing," *IEEE Transactions on Power Systems*, Vol. 20, No. 1, pp. 230-238, February 2005.
[11] Y. Xu, F. Li, H. Li, D. T. Rizy, J. D. Kueck, "Using Distributed Energy Resources to Supply Reactive Power for Dynamic Voltage Regulation," *International Review of Electrical*

Copyright © 2009 Praise Worthy Prize S.r.l. - All rights reserved

Engineering (IREE), Vol. 3, Issue 5, pp. 795-802, Oct. 2008.
[12] F. Li, W. Zhang, L. M. Tolbert, J. D. Kueck, and D. T. Rizy, "A Framework to Quantify the Economic Benefit from Local VAR Compensation," *International Review of Electrical Engineering (IREE)*, Vol. 3, Issue 6, pp. 989-998, Dec. 2008.
[13] R.E. Brown and L.A.A. Freeman, "Analyzing the reliability impact of distributed generation," *IEEE PES Summer Meeting 2001*, Vol. 2, pp. 1013-1018, July 2001.
[14] P.A. Daly, J. Morrison, "Understanding the potential benefits of distributed generation on power delivery systems," Rural Electric Power Conference, 2001, pp. A2-1 to A2-13.
[15] T. E. McDermott, R. C. Dugan, "Distributed generation impact on reliability and power quality indices," *Rural Electric Power Conference*, 2002, pp. D3-1 to D3-7.
[16] Y.G. Hegazy, M.M.A. Salaama, and A.Y. Chikhani, "Adequacy Assessment of Distributed Generation Systems Using Monte Carlo Simulation," *IEEE Trans. on Power System*, Vol. 18, No. 1, pp. 48-52, Feb. 2003.
[17] C.L.T. Borges, D.M. Falcao, "Impact of distributed generation allocation and sizing on reliability, losses and voltage profile," *2003 PowerTech Conference*, Bologna, Italy, June 2003.
[18] D. Zhu, R. P. Broadwater, Kwa-Sur Tam, R. Seguin, and H. Asgeirsson, "Impact of DG placement on reliability and efficiency with time-varying loads," *IEEE Trans. on Power Systems*, Vol. 21, No. 1, pp. 419-427, Feb. 2006.
[19] C. H. Ng, T. T. Lie, and L. Goel, "Impacts of distributed generation on system reliability in competitive electricity markets," *International Power Engineering Conference (IPEC) 2007*, pp. 735 – 740, Dec. 3-6, 2007.
[20] R.E. Brown, "Reliability Benefits of Distributed Generations on Heavily Loaded Feeders," *IEEE PES General Meeting 2007, Tampa*, FL, June 2007.

E-PRINT

Authors' information

[1] The University of Tennessee, Knoxville

[2] Engineering Planning and Management (EPM)

Fangxing (Fran) Li received the Ph.D. degree from Virginia Tech in 2001. He has been an Assistant Professor at The University of Tennessee (UT), Knoxville, TN, USA, since August 2005. Prior to joining UT, he was a principal engineer at ABB Electrical System Consulting (ESC). His current interests include energy market, reactive power, distributed energy resources, distribution systems, and reliability. Dr. Li is a Senior Member of IEEE and a registered Professional Engineer (PE) in the state of North Carolina.

Nura Sabir received her B.S. in Electrical Engineering from Tuskegee University in 2005 and M.S. in Electrical Engineering from The University of Tennessee in 2008. She is presently working at Engineering Planning and Management (EPM).

Copyright © 2009 Praise Worthy Prize S.r.l. - All rights reserved

International Review on Modelling and Simulations (IREMOS)

Aims and scope

The ***International Review on Modelling and Simulations (IREMOS)*** (**www.praiseworthyprize.com/iremos.htm**) is a peer-reviewed journal that publishes original theoretical and applied papers concerning:

Modelling, Numerical studies, Algorithms and Simulations in all the engineering fields. The topics to be covered include, but are not limited to theoretical aspects of modelling and simulation, methods and algorithms for design control and validation of systems, tools for high performance computing simulation. The applied papers can deal with Modelling, Numerical studies, Algorithms and Simulations regarding all the engineering fields; particularly about the electrical engineering (power system, power electronics, automotive applications, power devices, energy conversion, electrical machines, lighting systems and so on), the mechanical engineering (kinematics and dynamics of rigid bodies, vehicle system dynamics, theory of machines and mechanisms, vibration and balancing of machine parts, stability of mechanical systems, computational mechanics, mechanics of materials and structures, plasticity, hydromechanics, aerodynamics, aeroelasticity, biomechanics, geomechanics, thermodynamics, heat transfer, refrigeration, fluid mechanics, micromechanics, nanomechanics, robotics, mechatronics, combustion theory, turbomachinery, manufacturing processes and so on), the chemical engineering (chemical reaction engineering, environmental chemical engineering, materials synthesis and processing and so on.

Instructions for submitting a paper

Contributions may consist of invited tutorials or critical reviews; original scientific research papers (regular paper); letters to the Editor and research notes which should also be original presenting proposals for a new research, reporting on research in progress or discussing the latest scientific results in advanced fields.
All papers will be subjected to a fast editorial process.
Any paper will be published within two months from the submitted date, if it has been accepted.

Papers must be correctly formatted, in order to be published. Formatting instructions can be found in the last pages of the Review. An ***Author guidelines*** template file can be found at the following web address:
http://www.praiseworthyprize.com/Template of IREMOS.doc

Manuscripts should be sent via e-mail as attachment in .doc and .pdf formats to:
editorialstaff@praiseworthyprize.com or **santolo@unina.it** (Editor-in-Chief)

The regular paper page length limit is defined at **15** formatted Review pages, including illustrations, references and author(s) biographies.
Pages 16 and above are charged 10 euros per page.

After a paper has been accepted, the author or the author's organization will be requested to buy 4 copies of the Review issue to cover part of the publication cost.

Subscription rates:

on Cd-Rom, per year:		***Print copy, per year:***
Institutional:	150 (euros)	240 (euros)
Individual:	120 (euros)	210 (euros)
Individual Article:	15 (euros)	25 (euros)

Abstracting and Indexing Information:

Academic Search Complete - EBSCO Information Services
Cambridge Scientific Abstracts - CSA/CIG

Autorizzazione del Tribunale di Napoli n. 78 del 1/10/2008

(continued from outside front cover)

PWP
Praise Worthy Prize

€ 40,00

1974-9821(200908)2:4;1-M

Copyright © 2009 Praise Worthy Prize S.r.l. - All rights reserved