

Edgard Gnansounou, Abdelaziz Lahlou

SECURITY OF ELECTRICITY SUPPLY IN A LIBERALIZED ENVIRONMENT: AN AGENT BASED APPROACH WITH APPLICATION TO THE CASE OF SWITZERLAND

Laboratory of Energy Systems (LASSEN), Ecole Polytechnique Fédérale de Lausanne
E. Gnansounou: EPFL-ENAC-LASSEN
Bâtiment GC-A3 399, Station 18CH – 1015 Lausanne, Switzerland
Phone: +41 21 6930627, Fax: +41 21 6932863, E-mail: edgard.gnansounou@epfl.ch

Overview

Due to the Power shortages in several industrialised countries during the last decade, the issue of security of electricity supply (SES) gained in importance. The ongoing liberalisation processes are changing the traditional paradigm of SES based on a centralised assessment. The need of a new approach that could combine the behaviours of the various actors in a consistent way is widely acknowledged. In this paper, a cooperative and agent-based approach is proposed that makes involved the market participants. The concept of this model has been developed and application to the case of Switzerland is being performed. Electricity generation in Switzerland is mainly based on hydropower and nuclear; winter is the critical season due to the reduced hydro inflows and to the higher electricity demand. Historically, the issue of SES in this country was linked to the development of nuclear power plants. Before receiving authorisation for constructing a new nuclear power plant, the electricity utilities had to prove the evidence on the need of that plant for assuring a prescribed level of SES. The long term adequacy between electricity demand and supply in Switzerland depends both on the lifetime end of the nuclear plants and long term import contracts.

Methods

The issue of Security of electricity supply in Switzerland was worked out in our Laboratory since the eighties after the second oil crisis. Gnansounou (1992, 1994) developed a method using probabilistic and fuzzy numbers for modelling the adequacy between electricity demand and supply in Switzerland. This model has been adapted and extended for appraising economic performance of contracts in Electricity Markets (Schmutz and Gnansounou, 2002, 2004). Then a Multi-Agent Architecture for Market oriented Planning in Electricity Supply Industry was developed (Gnansounou et al., 2004a, 2004b, 2004c) and the Greek case was assessed (Gnansounou et al., 2005). The method used in the present paper integrates parts of the models developed for many decades in our laboratory with the aim to assess the SES using a cooperative process between the regulator and the other market participants. The agents who are involved in those interactions are as follows: the regulator, transmission system operator, generators, municipal energy companies and consumers.

Results

The conceptual model presented in this paper evaluates the level of security of supply as a result of interactions between the agents. The first results of the application to the case of Switzerland are presented as well. The main findings show that the electricity supply in Switzerland would begin to be inadequate around the winter 2020, depending on the competitiveness in the Swiss electricity supply industry (ESI), the SES level and criteria adopted by the regulator and his ability to promote them, the electricity demand growth.

Conclusions

The preliminary results obtained from the Swiss case study showed that the SES in a liberalised environment will depend mainly on the design and operation of the electricity market. However, considering the scale of the Swiss market compared to the large European Electricity market, the Electricity supply of the Swiss consumers appeared to be nothing but critical as long as the interconnections with the neighbours and the transmission network are well adjusted. Other aspects that should be deepened concern how the supply profiles would match the public energy policy.

References

- Gnansounou Edgard, Lahlou Abdelaziz, Polychroniou George (2005) "Joint indicative planning of electricity and natural gas supply systems: the case of Greece", Proc. of the 28th Annual IAEE Int. Conf., Taipei, Taiwan, June 2005.
- Gnansounou edgard, Pierre Samuel, Quintero Alejandro, Dong Jun, Lahlou Abdelaziz (2004a) "Toward a Multi-Agent Architecture for Market Oriented Planning in Electricity Supply Industry," accepted by The International Journal of Power and Energy systems.
- Gnansounou Edgard, Dong Jun, Pierre Samuel, Quintero Alejandro (2004b), "Market Oriented Planning of Power Generation Expansion using Agent-based Model" IEEE PES, New York, Oct. 10-13, 2004.
- Gnansounou Edgard, Dong Jun (2004c) "Agent-based Model for market oriented Planning of Electricity Generation Expansion", 6th IAEE European Energy on "Modelling in Energy Economics and Policy" Zurich, Sept. 2004.
- Schmutz Alain , Gnansounou Edgard (2004) "Appraisal of Portfolios of Assets in Electricity Markets: Risk Measures under Vagueness and Flexibility", Zeitschrift für Energiewirtschaft, 29//Helf 2 (2004) 147-156.
- Schmutz Alain, Gnansounou Edgard, Sarlos Gérard (2002) "Economic Performance of Contracts in Electricity Markets: a Fuzzy and Multiple Criteria Approach", IEEE Transactions on Power Systems, Vol. 17, Issue 4(2002) 966-973.
- Gnansounou Edgard (1994), "Strategic planning and reliability assessment for a hydro dominated power system: case of Switzerland", Conf. on Modelling, Testing & Monitoring for Hydro Powerplants, Budapest, July 1994.
- E. Gnansounou., G. Sarlos (1992) "Evaluation of Adequacy of the Electric Energy in Uncertain Environment: Case of Switzerland", in Coping with the Energy Future : Markets and Regulations. 15th Annual Int. Conf., IAEE, Proceedings 1 Tours, France, 18-20 May, 1992