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LONG-TERM TRANSMISSION NETWORK EXPANSION PLANNING CONSIDERING THE ECONOMIC CRITERIA AND THE FLOW- BASED MARKET MODEL

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OVERVIEW

Planning of the transmission network upgrade and expansion has been strongly influenced by the opening of electricity market in Europe. Before the deregulation process, transmission planning departments were part of vertically integrated power generation/supply companies. The main aim of reinforcements was to ensure economical dispatch of existing and future power plants, taking into account security of supply, i.e. proper level of consumption increase. Therefore, network expansion planning was optimised in line with minimal expenses criteria, and more or less, based on technical needs of a specific geographical area.

Under the market conditions, several issues could have an influence on the transmission network planning process:

- lack of data needed for planning process (size and location of the new power plants);
- bidding behaviour of existing/new power plants owners;
- elasticity of consumption (i.e. consumers reaction on the high/low market prices);
- different view on transmission development from influential parties (producers, traders, suppliers, consumers, regulators);
- changes in the electricity market design;
- disproportion between technical, economical, environmental and social requests.

Although transmission planners were faced to different uncertainties before, existing and new uncertainties make transmission planning more difficult.

METHODS

For the analysis of change in social welfare, flow-based methods for the allocation of transmission rights have been used [1]. As the flow-based allocation procedure itself respects the physical impact of commercial activities by converting them into an (estimated) flow patterns for the entire region, this method would be appropriate for the assessment of critical network elements (lines, transformers) on a regional level, based on their shadow prices (outcome of allocation process). Additionally, this allocation method simultaneously ensure a higher system security in comparison with widely applied commercial (NTC) allocation methods.

Based on a cost-benefit analysis, true regional valuation by society of the predefined transmission network enhancement project is estimated. The predicted future changes in size and location of generation/consumption patterns have been taken into account during the analysis.

All the benefits have been grouped into the following categories:

- (a) social welfare increase on a regional level (defined as reduction in production and consumption costs on a regional level);
- (b) operational security increase for TSOs, congestion cost (redispatch) reduction and decrease of network losses on a regional level;

All costs of a network reinforcement project have been grouped into the following categories:

- (a) capital costs of building a new line;
- (b) operational and maintenance costs (O&M) over the life of a line;
- (c) environmental impact;

Profitability index has been used in order to estimate the benefits of an investment along with the NPV method which helps to convert all costs/benefits into the present value using appropriate discount rate.

RESULTS

In this paper the analysis, performed on the small test system [2], has shown the main advantages and drawbacks of proposed network investment method. The effective usage of transmission planning criteria and methodology proposed in this paper would lead to the network investments with regional significance and increased level of trading activities. Additionally, the possible implementation of flow-based allocation method could potentially lead to the establishment of stable (regional) financial mechanism that could support regionally important projects.

CONCLUSIONS

The optimization function used for the integration of electricity markets is maximization of social welfare. Therefore, under the open-market conditions, attention should be drawn to the regionally and economically efficient investments which would lead to increase in sum of net market surpluses and the total regional congestion income in comparison to the market outcome in case before the proposed investment (base case). In this paper, it was clearly shown that regional coordination which has already been reached in Europe in relation to cross-border capacity allocation would inevitably lead to necessity to a higher level of coordination when it comes to the network investment decisions.

REFERENCES

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