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LITHUANIAN ENERGY SECURITY LEVEL VARIATION DUE TO IGNALINA NUCLEAR POWER PLANT SHUTDOWN

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OVERVIEW

Paper presents investigation on impact of Ignalina Nuclear Power Plant (NPP) shutdown on Lithuanian energy security. The system of energy security indicators, covering technical, economical and socio-political aspects is presented. The integral characteristic of these indicators shows the level of energy security. Paper represents Lithuanian energy security level in 2007. In addition forecasted energy security level in 2010 after shutdown of Ignalina NPP, when Lithuanian Power Plant in Elektrėnai becomes the main electricity producer, is analysed. Two alternatives are analysed: Lithuanian Power Plant uses either gas or heavy fuel oil for electricity production. The security level of each indicator, each indicator block and total security level are presented as the result. Energy security indicators, which increased or decreased after shutdown of Ignalina NPP are analysed.

METHOD

Basis for calculation of energy security level is security indicators. Security indicator is a special index, which gives numerical values to important issues for security of energy sector. Using indicators one can evaluate both the state of country's security of electric energy supply and separate parts of country's energy sector, e.g. transport or nuclear sector. The indicator system must meet certain requirements to be suitable for assessment of the analysed object. The main principles of indicators, presented in the work, are science-based, functional, and pragmatic ones. Since the task to assess security of energy supply is interdisciplinary, the blocks (technical, economical, socio-political and environmental) are representing these fields [1].

Each indicator is denoted as X_{ijk} , where $i = 1, \dots, 3$ – number of block, $j = 1, \dots, m$ – a row number indicator in the block, $k = 1, \dots, l$ – iteration number (iteration number depends on the number of modelling years). For the assessment of system state a 15 points scale is used. This scale is divided into three main parts – normal (11-15 points), pre-critical (6-10 points) and critical (1-5 points) states.

For the evaluation of the indicators state it is important the direction of each indicator scale. It can be increasing or decreasing. In the first case higher value of the indicator shows higher security level, in the second case – lower security level. If the direction of the indicators scale is decreasing, then the state of indicator is: normal, when normalized value of indicator $X_{ij}^n \leq pcv_{ij}$; pre-critical, when $pctv_{ij} \leq X_{ij}^n \leq ctv_{ij}$; critical, when $X_{ij}^n \geq ctv_{ij}$. If the direction of the indicators scale is increasing, then the state is: normal, when $X_{ij}^n \leq ctv_{ij}$; pre-critical, when $ctv_{ij} \leq X_{ij}^n \leq pctv_{ij}$; critical, when $X_{ij}^n \geq pctv_{ij}$ [2].

The weight of each indicator in the block s_{ij} and the weight of the each block s_i , here $i = 1, \dots, n$, $j = 1, \dots, m$ is calculated or evaluated by experts.

Security of energy supply level is evaluated regarding to weights of indicators and blocks as well as indicators' values in points by expression [3]:

$$B_k = \sum_{i=1}^n \left(s_i \sum_{j=1}^m (s_{ij} X_{ij}^p) \right), \quad k = 1, \dots, s .$$

here X_{ij}^p - value of the indicator in points.

CONCLUSIONS

The simulation result showed that shutdown of Ignalina NPP is not unambiguous for Lithuanian energy security level. It is natural that after the shutdown a part of energy security indicators worsened. It is related to the higher volumes of gas import and the increase of electricity prices. However, the shutdown of Ignalina NPP has a positive influence on Lithuania's energy security. First of all, it made prerequisites for the formation of free electricity market and wider choice of power producers for consumer. It can also positively assess the fact that after the shutdown of Ignalina NPP competition among electricity producers became possible and it led to an increased motivation to introduce renewable energy sources.

The aggregation of all the positive and negative consequences led to conclude that the shutdown of Ignalina NPP did not significantly change the Lithuanian energy security level. According to the method energy security level is approximately 7.3 in fifteen points scale and it is seen as pre-critical.

REFERENCES

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