Database for power system

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Abstract **The paper presents a proposition of a database structure for storage of the state of a power system, along with possible applications. An RDBM SQL system has been used. The power system states stored in a database can be used for extended power system state analysis, including past-time performance analysis. The data may be also used as an input for an optimal power flow (OPF) solver.**

Keywords **power system, database, SQL language, data storage.**

I. INTRODUCTION

This paper presents a structure and applications of a database containing a description of a configuration and states of a power system. The database enhances the possibilities of past power system state analysis, and the data stored in it may be used as a source for the power flow analysis and optimisation (OPF) engines.

II. THE MODEL OF THE POWER SYSTEM

For practical reasons, the authors have chosen to unify production and consumption nodes [1] (Fig. 1). While increasing database size, this approach reduces the software complexity and improves performance. Such unified nodes are connected together with power lines modelled as ∏-type networks (Fig. 2).

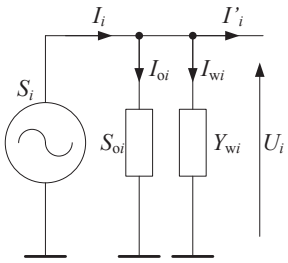

Fig. 1. The model of a unified power system node

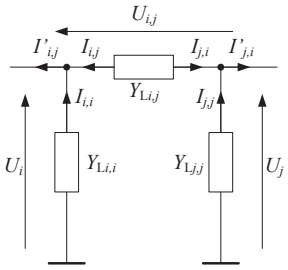

Fig. 2. The model of a power line

where: S_i – passive power generated by the node,
S_{oi} – passive power consumed by the node,
Y_{wi} – admittance representing the node's auxiliaries,
Ui – voltage at the node.
$Y_{Li,i}$, $Y_{Lj,j}$ – admittance representing auxiliaries of nodes i and j,
$Y_{Li,i}$ – series admittance representing power transfer losses.

III. THE STRUCTURE OF THE DATABASE

The PostgreSQL relational database management system has been chosen for the database implementation. Fig. 3 presents the structure of the database.

In addition to the parameters of power system nodes and lines (Fig. 1 and Fig. 2), the database stores information required for power flow analysis and optimisation, such as nominal power consumption and power generation and transfer constraints.

The design is composed of seven relations:

- ***ps_system*** – stores information about all power system described by the database,
- ***ps_nodes*** – stores parameters of all power system nodes (unified production and consumption nodes),

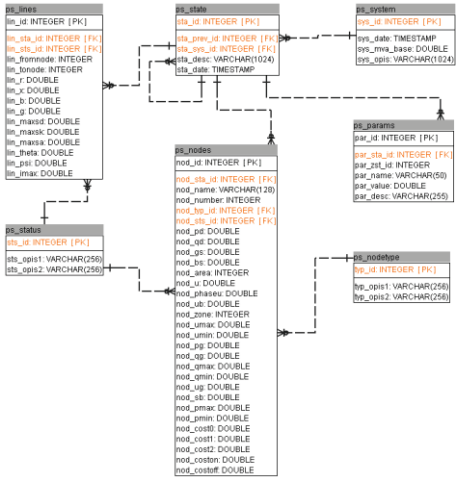

Fig. 3. The structure of the described database

- ***ps_lines*** – stores parameters of all power lines (including transformers, phase shifters etc.),
- ***ps_status*** – stores all possible node and line states, along with their descriptions,
- ***ps_state*** – stores distinctive power system states,
- ***ps_nodetype*** – stores descriptions of all power system node types,
- ***ps_params*** – stores a list of parameters used for the power flow optimisation process for a given power system state,

The database design supports power flow analysis and optimisation, but may be further extended to cover other applications, such as transient state analysis.

IV. CONCLUSION

The presented database design has been implemented and thoroughly tested as a part of the N511 001 32/0852 Polish research grant. The application of the design allowed flexible storage of different power system configurations and states, representing different power systems and their state after different OPF runs.

Along with the MVC design pattern and reflection-based database integration [2], a wide set of functionality may be implemented in software with reduced amount of work.

V. REFERENCES

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