

Operational realistic power system simulation using the PowerSystemHandler

Special 2005 edition for student lab applications

Today's Electricity supply industry forces to operate the entire power systems closer to their limits on the most cost effective base. To cope with these requirements engineers are facing new challenges in power system design and planning and in real time operation including the operational planning as well.

During the past years DUTrain has developed the PowerSystemHandler (PSH). The PSH is based on a full scale operator's training simulator displaying realistic performance of electricity supply systems in operational time frame. The PSH has proven its capability in a lot of training sessions covering system states from normal operating conditions up to blackout scenarios. Furthermore PSH demonstrated also its capability in the education of newcomers to the operational world.

DUTrain offers a special **PSH bundle for Universities** dealing with the education of electrical engineers in the field of power systems' engineering. Used in lab exercises the PSH gives insight into

- the operational performance of single pieces of equipment and the entire system,
- the technical phenomena occurring in power system operation under all system states,
- the interaction of power production, consumption and the electricity grid.

The simulation tool PowerSystemHandler

The DUTrain PowerSystemHandler is a unique tool for simulating power system operations. Its technological design is based on almost a decade of experience in operator training. The PSH briefly described consists of

- a SCADA system
- Models for the technical equipment
- Power system calculation engine

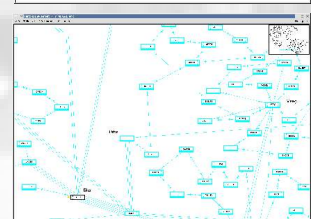
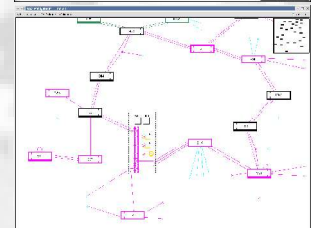
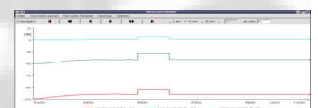
The SCADA system comprises the operational user interfaces and the process data handling. The telemetric line interface is used for the connection of, and the data exchange with, the models for the technical equipment such as switching and protection devices, automatic tap changers, generation units, load performance, etc. The power system calculation engine simulates the physical performance of the entire power system represented by the actual topology retrieved from the SCADA system and the physical parameters of its equipment (e.g., line and transformer impedances, generation capability, load trajectories). The calculation results are sent back to the SCADA system as measurement values.

Additional features of the DUTrain PSH are:

- Representation of power system control hierarchical organisation comprising several control centres in parallel.
- Splitting of grid control and generation control, each represented in specifically customized control centres.
- Capability of technical equipment models and power system calculation engine for 'normal' and 'abnormal' operational conditions up to system restoration after full blackouts.

- Powerful scenario management.

The simulator proved its operational realism during training sessions with real operators an real power systems.



PSH user interfaces

PSH application in student labs for power system operation and controls:

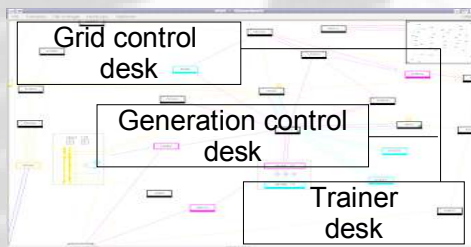
- ★ Demonstrating the technical performance of different types of power generation units.
- ★ Demonstrating the technical performance of grids and grid devices.
- ★ Understanding the mutual influence of grid operation and generation.

The lab comprises

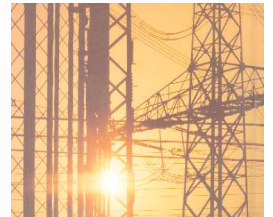
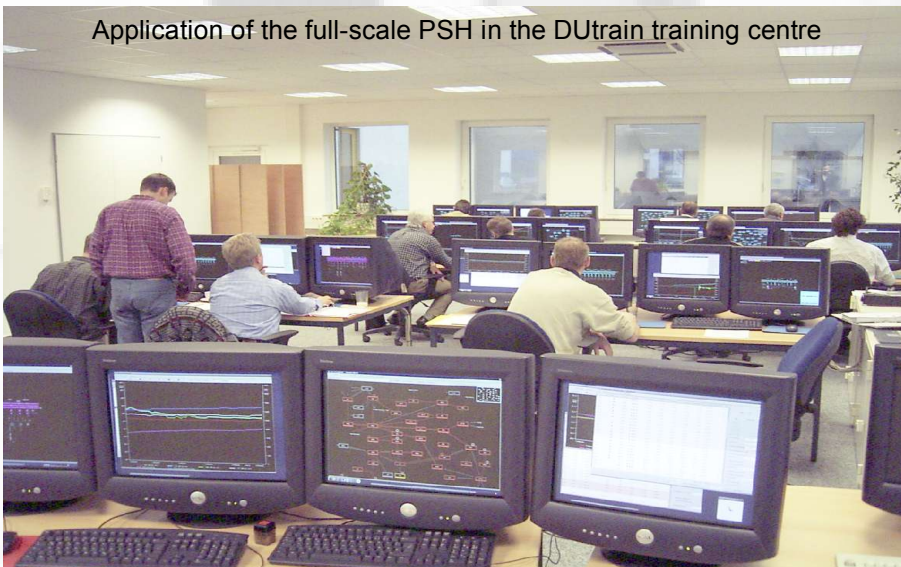
- ★ Practical exercises in grid and generation operation / dispatch.
- ★ Operational planning tasks.
- ★ Technical disturbance clearing.
- ★ Operational verification of planned grid-extensions.
- ★ Lab documentations and introduction to the PSH

Configuration of the university bundle

- ★ The PSH-software needs at minimum three standard PCs, with the SuSE Linux Professional 8.2 operating system (Kernel 2.4), 256MB RAM.
- ★ The PSH is a network-application, at minimum a 100MBit-network is required.
- ★ Dual head 21"-monitor configuration for each workplace are recommend.
- ★ The students work on a fictive test grid, containing characteristic devices and configurations in European style. The test grid may be adopted to special lab requirements.



Application of the full-scale PSH in the DUtrain training centre



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