Europäischen Union stattfindet. Vor allem sindt es die USA und China. Nicht umsonst heißt es „In Europa ist es wolkig, in Asien ist es sonnig“.

Literatur:

1. http://oursocialmedia.com/germany/firstsolar/grostes-solarkraftwerk-in-deutschland-eroffnet/.
2. http://www.facepla.net/index.php/content-info/art-menu/2033-top-10-pv-power-plant.
3. http://www.facepla.net/index.php/the-news/energy-news-mnu/2413-solar-record-germany.
4. http://www.erneuerbare-energien-und-klimaschutz.de/artikel/konzenson2/index.php.
5. http://pronedra.ru/alternative/2013/09/25/solnechnye-paneli/.
6. http://energysafe.ru/alternative_energy/alternative_energy/965/.
7. http://sol-energy.blogspot.ru/.

Kornelyuk, I.A., Sokolova, E.Y.

Digital Relays vs. Analogue Ones

National Research Tomsk Polytechnic University.

The paper shows the trend in replacement of the analogue relays by digital ones. The reasons for their replacement are also considered in the given paper. It is concluded that digital relays are more reliable, fast, compact and possess various operation functions.

The role of protective relaying in electric-power system is explained by a brief examination. There are three aspects of a power system that will serve the purposes of this examination. These aspects are normal operation, prevention of electrical failure, and the reduction of the effects caused by electrical faults.

A protection relay is a smart device that receives input signals, compares them to set points, and provides output signals. This is common for all types of relays (electromechanical, static and digital devices). The input signals can be current, voltage, resistance, frequency or temperature. Outputs can include visual feedback in the form of indicator lights and/or an alphanumeric display, communications, control warnings, alarms, and turning power off and on.

The first protection relays used for power system protection were electromechanical analog devices. Over the last 40 years electromechanical relays have been progressively superseded, firstly by static analogue relays then by digital relays. The development of digital relays has lowered cost and provided greater functionality within each relay.

The protective relaying causes fast removal and disconnection of any element of the power system when it suffers short circuits or is under abnormal and emergency conditions. Relay protection sometimes is even more reliable than the station operators or attendants. The operator needs some time to evaluate the situation and correct it before any harmful consequences develop while the relays respond fast and are able to tackle this problem quickly.

It is well-known that each generator, transformer, bus bar, overhead transmission line are equipped with different types of circuit breakers. Thus, any element can be completely disconnected from the power system. Moreover, the protective relays provide identification of the location and type of failure.

The functional characteristics of any protective-relaying equipment are:

- speed.
- selectivity.
- sensitivity.
- reliability.

First of all, any relaying equipment must be sufficiently sensitive so that it will operate reliably. It must be able to select between those conditions for which prompt operation is required and those for which no response is necessary.

One of the basic requirements of the protective relaying equipment is reliability. Other things being equal, simplicity and robustness contribute to reliability, but they are not of themselves the complete solution. Human factor must be taken into account too.

Like all other parts of a power system, protective relaying should be evaluated on the basis of its contribution to the best economically possible service to the customers. The contribution of protective relaying is to help the rest of the power system to function as efficiently and as effectively as possible in the face of trouble. How protective relaying does this is as follows:.

- by minimizing damage when failures occur,.
- by the cost reduction of repairing the damage;
- by minimizing the likelihood that the trouble may spread and involve other equipment;
- by the time spent during the period when equipment is out of service.
- By the loss in revenue and the strained public relations while the equipment is out of service [4].

Electromechanical relays

Electromechanical relays have been in use for almost 100 years and are still in use for typical utilities throughout their power system. They have earned a well-deserved reputation for accuracy and reliability.

The electromechanical protective relay converts the voltages and currents to magnetic and electric forces and torques that press against spring tensions in the relay. The tension of the spring and taps on the electromagnetic coils in the relay are the main processes by which a user sets in a relay.

These relays are usually instantaneous in action, with no intentional time delay, closing as soon after pickup as the mechanical motion permits. Time delay can be added by means of a dashpot, or a clockwork escapement mechanism.

However, the timing accuracy is considerably less precise than that of digital relays.

Limitations of electromagnetic relays.

- Low speed of operation.
- Characteristics change during exploitation due to ageing effect.
- Component failure causes relay failure.
- Relay is massive: Because there are internal mechanical components with physical dimension restraints, the package size of an electromechanical Relay can limit the size of a PCB design Excessive power consumption.
- Imposes high burden on CT.
- Electromechanical relays must make mechanical contacts in order to switch a load. At the point of these contacts, oxidation breakdown occurs over extended life cycling (typically 100 operations), and the relay will need in maintenance.
- Bounce occurs at the contact site over a period of activated relay . Bounce creates a time interval where the load circuit is flickering between open and closed, a condition which may need to be considered in load design.

Digital relays

Digital relay is state-of-the-art relay that uses a microprocessor to analyze power system parameters for detection of faults in process system. Digital relays can manage system pro-

tection, communication and coordination more precisely and economically than traditional analog electrical-mechanical relays. Numerical algorithms are used in digital relays so any device can be easily duplicate any of the ANSI protection functions with computer program.

A digital relay consists of processor, analogue input system, digital output system and independent power supply. Figure 2 presents a simplified block diagram of a digital relay.

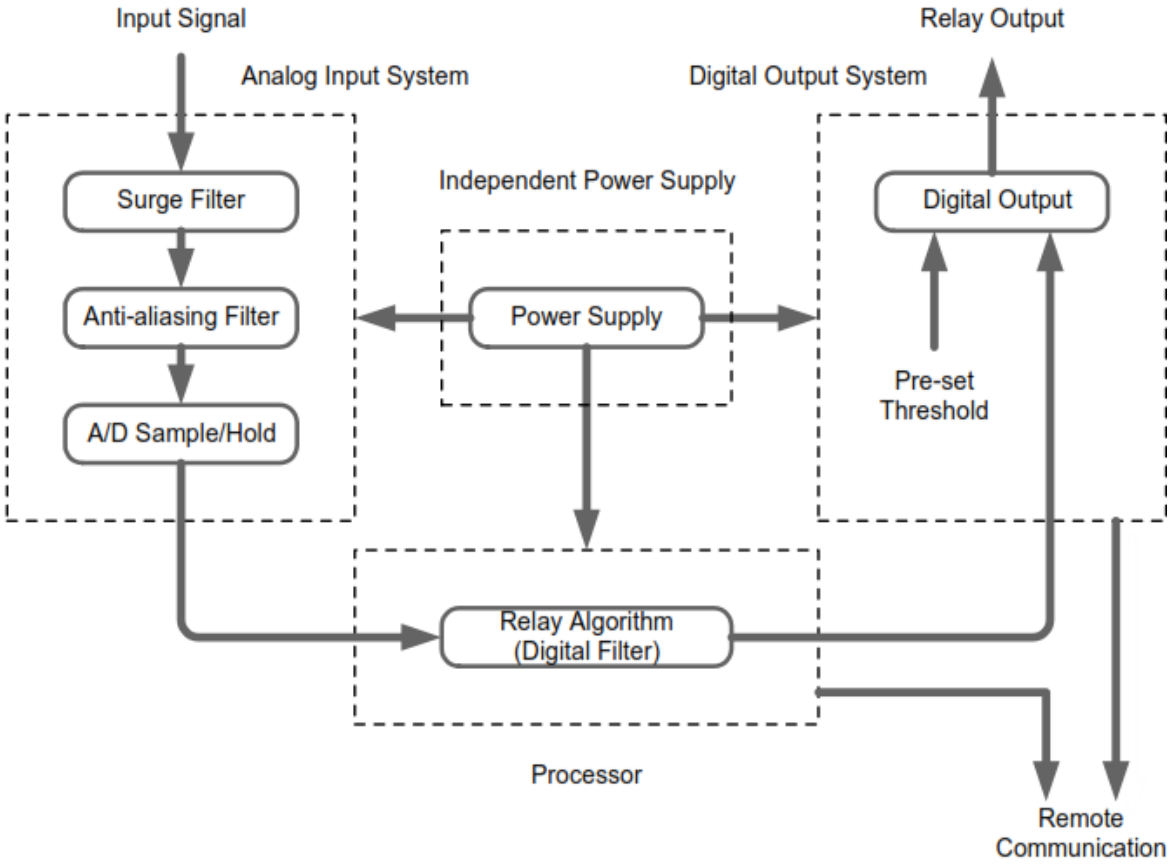

Fig. 2. Block diagram of a digital relay.

The way of input signal processing is the main difference between analog relays and digital relays.

Current transformers and potential transformers generate only analog signal which is input signal. In the case of digital relays, the input signals are converted into digital signals before being processed.

The core of the digital relay is the relay algorithm stored in the processor. It determines the way to reconstruct the input signal based on the digital samples from the A/D converter. As the input signal may contain unwanted components such as harmonics and dc, the algorithm is designed to remove them as much as possible. The algorithm functions as a digital filter to extract the fundamental component of the input signal. The relay operation is carried out based on the fundamental component.

In digital output system, a detection function is calculated based on the reconstructed signal. Such calculated function is then compared with the preset threshold. The decision on whether the relay should operate is made according to this comparison. Sometimes an additional time delay is needed before the trip signal is sent out.

Advantages of digital relays

The main advantages of digital relays are as follows:.

- One digital relay can replace a bank of analog devices.
- Custom functions can be programmed.
- Communication over a PMCS (Power Management Control System).
- Time stamped event recording.
- Self-monitoring.
- Reduced panel space.
- Lower burden.
- Improved performance.
- High seismic withstand.

But these advantages are not limited by the mentioned above.The main drawbacks are listed below:

- Short lifetime due to the continuous development of new modern technologies. Their operation response becomes obsolete rapidly.
- Susceptibility to power system transients.
- The complex and sophisticated design and construction of digital relay protection system requires specially trained staff for proper maintenance of the settings and monitoring data.

Nowadays digital relays are the most reliable, fast, multifunctional equipment.

They haven't drawbacks of analogue electromechanical ones. It's preferable to use digital relays for design new protective relaying.

References:

1. Zamora I., Mazón A. J, Valverde V., Torres E., Dyśko A. Power Quality and Digital Protection Relays/International Conference on Renewable Energies and Power Quality (ICREPQ'04). Barcelona, 2004.
2. http://electrical-engineering-portal.com.
3. Fan Wang. Power Quality Disturbances and Protective Relays. Component Switching and Frequency Deviation/Department of Electric Power Engineering, Chalmers University of Technology. Göteborg, 2003.
4. Mason, C. Russell. The Art and Science of Protective Relaying/General Electric. Retrieved 2009-01-26.
5. Brad Henderson . Protection relay settings management in the modern world/ CIGRE Australia Panel B. Melbourne, 2009.

Korshunov K., Tarasova, E.S.

Comparison of gas reciprocating and gas turbine power units

National Research Tomsk Polytechnic University.

1.Introduction.

Power units or drive electric generators for isolated plants can be diesel, gas reciprocating, micro-turbine and gas turbine engines. A large number of controversial and polemical articles were written about advantages of various generational installations and technologies. Thus, we will try to understand what is better. Fig.1 (left) – Gas reciprocating engine.

Determining the selection criteria for the construction of power units is autonomous power issues fuel consumption level of operational costs, as well as payback power plant equipment.