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ABSTRACT BOOK

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SESSION 1 – NETWORK COMPONENTS

Guarantee: David Mezera, EG.D, a.s.

NEW TRENDS IMPACT ON ENGINEERING SOLUTION OF DISTRIBUTION NETWORK ELEMENTS

Michal Šolle, PREdistribuce, s.r.o

There are new requirements for LV distribution network elements that are resulting from enhancing e-mobility recharge infrastructure, network automation and associated construction of fiber optic telecommunication infrastructure. This paper introduces an innovative distribution switchboard that was developed in regards with the safety, flexibility, implementation with existing compact transformer stations and minimization of production variants.

EXTENSION OF 22/0.4 KV DISTRIBUTION TRANSFORMER STATION WITH EXTERNAL CONTROL

Roman Kloubec, AZ Elektrostav, a.s., Milan Kloubec, ELTRAF, a.s.,
Milan Jelínek, Jaroslav Bořek, ČEZ Distribuce, a.s.

This paper deals with modification of existing, remote controlled distribution transformer station (DTS) build around concrete frame, which allows for upgrading the DTS with communication and control technology including fiber optic infrastructure. Modification is implemented in form of superstructure that is dimensionally the same as existing frame. Real world experience from “polygon” DTS prototype construction is mentioned as well.

ENGINEERING SERVICE LIFE MANAGEMENT OF HV/MV POWER TRANSFORMERS

Ing. Peter Frák, PhD. , Ing. Dominik Bokšanský, Východoslovenská distribučná, a.s.

HV/MV power transformers are the key elements of electricity distribution and their design and technological characteristics support long-term service. There are already machines in the system that are more than 50 years old, and the current state of the art makes it possible to carry out a sufficient amount of maintenance directly at the power station or to obtain a lot of data on the condition of individual machine parts in the form of diagnostics - "offline" or even in "online" mode. However, not all transformer weaknesses, sometimes leading to large-scale failure events, can be reliably identified. Therefore, it is always appropriate to address technical lifetime issues with implications for the safety and reliability of system operation, but also for the cost-effectiveness of transformer-related measures. The purpose of this paper is to summarize the available information and criteria on the status and importance, the evaluation of which should ultimately favor an appropriate decision leading, for example, to the total replacement of a particular machine or its continued operation.

TESTING OF METAL-CLAD MV SWITCHBOARDS AND MV/LV BLOCK TRANSFORMERS AFTER UPDATING THE APPLICABLE REGULATIONS

Milan Kloubec, ELTRAF, a.s., Martin Žurek, ABB s.r.o., Dalibor Sklenář, ABB s.r.o.

Due to their small size, modern metal-covered MV switchboards or their equipped MV/ MV block substations are increasingly being placed in densely populated parts of towns and villages, also in production areas. Since these substations, if not well designed and constructed, can pose a great danger to the operator and the public in the event of a fault, especially an accidental short circuit in the MV switchgear, it is increasingly important to examine MV switchgear and substations from the point of view of their safety. Updates to technical standards and related regulations have significantly tightened the testing requirements for metal-clad MV switchgear and MV/LV block transformers.

APPLICATION OF ACOUSTIC CAMERAS FOR DETECTION AND VISUALIZATION OF PARTIAL DISCHARGES

Václav Straka, "TMV SS" s.r.o.
Pavel Petráň, "TMV SS" s.r.o.

Acoustic cameras are an element that finds its application in the power industry in the detection and visualization of discharge activity. They allow not only the accurate detection of the phenomenon at a safe distance, but also the determination of the type of discharge and thus the possible cause and severity of the phenomenon. The paper includes not only a theoretical description of the function, but also practical examples that were taken by the authors of the paper during their field measurements in the Czech Republic and Slovakia. As examples, phenomena on both MV and HV elements will be used as well as their evaluation.

USE OF INNOVATIVE INSULATION SENSORS FOR MV VOLTAGE LEVELS

Drahomír Pernica, Ladislav Pospíchal, Jan Souček, MEgA – Měřící Energetické Aparáty, a.s.

Innovative isolation sensors are becoming an alternative to instrument transformers that are commonly used to measure voltages and currents. While maintaining the necessary insulation properties, isolation sensors are cheaper, lighter, easier to install, more operationally reliable and have more favorable frequency characteristics. They can be used both for measurement and for powering downstream equipment.

THE IMPORTANCE OF FLEXIBLE CURRENT SENSORS FOR AC CURRENT MEASUREMENT

Karel Kohout, ČEZ Distribuce, a.s.
Ladislav Pospíchal, MEgA – Měřící Energetické Aparáty, a.s.

Introduction to the principle, advantages and disadvantages of flexible current sensors and their comparison with classical current transformers. Application of flexible current sensors for AC current measurement in distribution transformer stations.

ONLINE PARTIAL DISCHARGE MEASUREMENT - RESULTS AND OPERATING EXPERIENCE OF THE UNIQUE PD-DOCTOR SYSTEM

Bedřich Beneš, Jiří Zaoralek; ModemTec s.r.o.

As society's dependence on electricity increases, the issue of the quality of power supply and the elimination of unexpected outages comes to the fore. This is made possible primarily by diagnostics and its tools. The rapid development of diagnostics goes hand in hand with the increasing complexity of diagnostic systems and new technical possibilities in the field of sensors and computing. Dozens of PD Doctor installations across Europe have proven their high added user value and reliability for customers. They have detected degradation of existing lines, helped eliminate high interference on HV lines, established the link between rainy weather and increasing partial discharge activity, for example, or helped save significant amounts of money by postponing originally planned power line replacements.

SYSTEM SOLUTION FOR PROTECTION OF BIRDS AGAINST ELECTRIC SHOCK ON MV OVERHEAD LINES

Kamil Čihák, ČEZ Distribuce, a. s.; Jan Volek, EG.D, a. s.; Vratislav Štěpka, EG.D, a. s.

The paper contains the development and history of the system solution, including the final output, see Electric Shocks to Birds (design) of bird protection against electric shock on overhead lines and related equipment (pole and pole transformer substations, switching elements) from 2015 to the present, which was carried out in cooperation with representatives of distribution system operators with representatives of the Ministry of the Environment (hereinafter referred to as the Ministry of the Environment), the Agency for Nature and Landscape Protection of the Czech Republic, the Czech Society for Ornithology, the Ministry of Industry and Trade, the Office for Technical Standardization, Metrology and State Testing, the Energy Regulatory Office.

SESSION 2 – POWER QUALITY AND EMC

Guarantee: Pavel Santarius, VŠB-TU Ostrava

RESULTS OF LONG-TEMR MONITORING OF VOLTAGE DIPS IN 110 KV NETWORK

Miloslava Tesařová, ZČU v Plzni, Katedra elektroenergetiky
Martin Kašpírek, EG.D, a.s.

The paper summarizes long-term monitoring results of 15 measuring points in 110 kV network between 2012 and 2020 (124 records). Voltage dip occurrence is assessed for each year, major dips being the main concern. History of level/system indicators (average number of recorded voltage dips) is assessed using three-year running average. Additionally, dips occurrence is evaluated for each supply areas.

DEVELOPMENT OF TRANSMISSION SYSTEM REGARDING THE POWER QUALITY AND REACTIVE POWER COMPENSATION

Oldřich Rychlý ČEPS, a.s., Tomáš Hába ČEPS, a.s., Jan Tesař ČEPS, a.s.

In the coming years, the electricity system (the "ES") will undergo several fundamental changes that will pose new challenges for the operation of the ES as a whole. In view of these changes, system operators are preparing their development plans. The transmission system operator (TSO) plans the development of the transmission system (TS) taking into account national needs but also international interests within the synchronous zone of continental Europe.

The gradual decline of conventional power plants connected to the TS of the Czech Republic will mean not only a reduction in the production and export of electricity abroad, but also limited possibilities to regulate reactive power. A larger share of intermittent renewables in electricity generation brings with it significant changes in power flows in the grid and also changes the possibilities of their regulation. Based on its development strategy, CEPS has started a gradual phase-out of the 220 kV system. This is leading to a gradual transition to a single PS 400 kV voltage level. In view of these significant changes, a strategy for reactive power compensation in the system is planned in terms of the gradual installation of compensating reactors in the PS. In this paper, it is presented which compensation elements and their placement is envisaged in the PS in order to ensure safe operation (in particular to ensure the required voltage quality of the PS and at the transfer points with the DS).

BUSINESS MEASUREMENT IN TRANSMISSION SYSTÉM IN THE CZECH REPUBLIC

Tomáš Martinec, František Rajský, Jan Dončuk, ČEPS, a.s.

Czech power transmission is one of the most important parts of power system not only in the Czech Republic but in Europe as well. CEPS operator goal is to ensure the regular function and safety of this system. Part of CEPS is the section that deals with all metering installed on domestic and interstate lines as well. The paper deals with description of establishing, existing state and future of electricity flow in CEPS. Possible methods for measuring and its implementation are explained. Future trends of business measurement and transmitted electricity power quality evaluation are outlined.

EXPERIENCE FROM PILOT PROJECT OF PQ CENTER IN PREDISTRIBUCE A.S. DISTRIBUTION NETWORK

Tomáš Sýkora, Radek Hanuš, Jiří Šika, Jan Hendrych – PREdistribuce, a.s.
František Kysnar, Jan Petrásek - EGC - EnerGoConsult ČB s.r.o.
Robert Ebel - MSTP, s.r.o.

Pilot project of PQ Center emerged from the needs of PREdistribuce to deploy new PQ meters in distribution stations and utilize new functionality for power quality evaluation in distribution network. Full final implementation was based on successful testing of small test case.

MEASUREMENT OF ENERGY AND POWER QUALITY USING MEG45 INSTRUMENT

Jiří Babka, Marcel Heide, Ladislav Pospíchal
MEgA - Měřící Energetické Aparáty, a.s.

Meg45 satisfies existing requirements for measurement and identification of transformer operational important phenomena with 1 millisecond synchronization, secure remote communication and service-free power supply. It represents easy-installed unit that is suitable for creating the systems with machine.

THUNDERSTORM AND DISASTER IMPACTS IN DS ON VOLTAGE EVENTS FREQUENCY – SPECIFIC SUPPLY AREA

Jan Petrásek, František Kysnar – EGC – EnerGoConsult ČB s.r.o., Jiří Vániš – ČEZ Distribuce, a.s.

The paper deals with meteorological conditions (thunderstorms, environmental disasters) on voltage event occurance frequency in DS. Assessment of voltage events was detailed on supply area of four specific 110/MV substations in CEZ Distribuce, a.s. Recorded voltage events were compared with CHMI data regarding the thunderstorms and with power supply continuity during sever environmental conditions (disasters). This assessment results in DTS territorial picture including the voltage events rate associated with thuderstorms and disasters. Thus, it was possible to identify the voltage event group, which the distributor is unable to affect. The assessment includes the specification of MAIFI and the impact of decreasing the voltage event occurance on improving MAIFI. The assessment was made repeatedly between 2017 and 2019. The paper contains even the summarization of voltage events occurance over the whole CEZ Distribuce supply area during 2019.

IMPORTANCE OF ACCURATE HARMONIC AND OSCILLOSCOPIC MEASUREMENTS WITHIN THE RANGE OF TENS KHZ

František Žák, Photomate s.r.o, Jiří Hula, ELCOM, a.s.

The paper deals with description of high frequency measurement importance. Based on the real measurement, there are specific phenomena described that were experienced within n this frequency range, including surprisingly high level of disturbance. The paper includes description of suitable measurement instruments ad well.

INTEGRATION OF STATIC FREQUENCY CONVERTERS FOR AC TRACTION MAINS INTO DISTRIBUTION SYSTÉM REGARDING THE POWER QUALITY

Lukáš Radil, Jan Klusáček, Jiří Dvořáček, Jiří Drápela, Ústav elektroenergetiky, FEKT, VUT v Brně

In context with supply the traction system with 25 kV/50 Hz AC rather than 3 kV DC, the requirement for symmetrical connection of supply station to the distribution system emerged. Selected concept that uses static frequency converters (SFC) satisfies necessary symmetrical consumption from superior distribution system and supports additional features for distribution system operator as well as traction system operator.

CONCEPT AND METHODS FOR MV/LV DTS AREA MONITORING IN EG.D DISTRIBUTION NETWORK

Michal Jurík, Jan Jiřička, Václav Hule, Tomáš Kos, Roman Kabele, Michal Kučera, Petr Honsa, Václav Petrášek, Martin Kašpírek; EG.D, a.s.

The paper deals with concept of electricity characteristic measurements at LV level of MV/LV distribution transformer stations (DTS) including data processing. It introduces the existing status and scheduled installation, which should cover almost 100 % of MV/LV DTS'. Selected monitoring solutions for each transformer station type are described. The paper discusses the engineering solution of monitoring itself (common solution vs monitoring with integrated source and modem).

MOBILE 22 KV, 5MVAR CAPACITOR BATTERY FOR VOLTAGE STABILITY SUPPORT DURING LOAD CHANGE IN DS

Pavel Bürger, EGC-EnerGoConsult ČB s.r.o.
Stanislav Hes, Jan Švec, ČEZ Distribuce, a. s.

Voltage stability in distribution networks is about to increase its importance as the distribution network load rise and with higher penetration of distribution energy resources (RES). Load dynamics in some areas overwhelm the means of distribution system operator to adequately improve the generation capacity as well as enhancement of network itself. The 22 kV Kraliky area is one of such areas, where required load increased particularly during winter. Capacitor battery (22 kV/5 MVAr) with stepped control was proposed to stabilize the voltage within the range specified by CSN EN 50160 and to avoid the voltage dips at the terminal ends. This installation is just a temporary solution until the network enhancement will be implemented. The paper contains the description of analyzation, design and implementation of capacitor battery, which was installed in 22 kV Kraliky switching substation.

SESSION 3: OPERATION, CONTROL AND PROTECTION

Guarantee: Petr Toman, VUT Brno

Protection

RELATIONSHIP BETWEEN TRANSFORMER AND STATION PROTECTIONS

Jiří Berman, Hitachi Energy Czech Republic

In normal operating practice, little attention is paid to the context - the transitions in protection between different types of equipment. It is common to pay precise attention to the backup of lines between each other, and this inadvertently implies the protection of substations, but everywhere the protection of substations with protection from transformers, let alone lines, is no longer taken into account, and on the other hand, the backup protection of transformers from the network is again neglected. Case by case, such protection can be enforced - this is when someone from the engineers, but rather from the economists, the plant operators understand the importance of taking this into account; but usually already on the basis of sad experience with accidents. Thus, when two decades have passed since the indicated connections were monitored by the regional control room, it is necessary to draw attention to them at least in this way.

EXPERIENCE WITH A NEW METHOD OF TUNING SUPPRESSION CHOKES USING MULTI-FREQUENCY INJECTION

Ivan Matuljak, Petr Vančata, David Tomáš, EGE, spol. s r.o.

The resonant method is increasingly inadequate for tuning of inductors in compensated networks. To ensure reliable tuning of inductors even in very large and symmetrical networks and in networks with significant node voltage fluctuations, a new tuning method using current injection has been developed using a real current source generating a signal composed of several frequency components simultaneously. In addition, a method of indirectly measuring network parameters has been developed so that the device does not need the use of an external voltage measurement. Thus, using a relatively small, low-power device, reliable inductor tuning is possible even for large-scale networks, even when the inductor is highly detuned with respect to the network and the natural node voltage values are extremely low. The presented new tuning method has had several months of successful verification operation in a real network.

SMART MV SWITCHBOARD WITH SENSORS – RELIABILITY IN REAL DISTRIBUTION SYSTEM OPERATION

Michal Jurík, Radek Hochmann, Jiří Černoch, Lubomír Podrazil, E.ON Distribuce, a.s.

The paper provides results of operational tests of smart MV switchboards, which were installed, as pilot project, in distribution transformer stations MV/LV within E.ON Distribuce a.s. distribution network in Brno-Bohunice. These smart MV switchboards are used there for measuring power quantities, fault detection, communication and remote control of switching elements. Measuring sensors were used

within the smart MV switchboards and one of the main goals was to compare their reliability with measuring transformers.

COMPREHENSIVE SYSTEM FOR FAULT LOCALIZATION IN 22 KV NETWORKS

Martin Horák, Západoslovenská distribučná, a.s.

Following systems were developed and employed in Zapadoslovenska distribucna a.s. to fast and reliable localization of fault in 22 kV network during last 15 years – transition fault current indicators in DTS, remote controlled DTS' with PPP indicators, remote controlled section disconnector with PPP, 22 kV lines short-circuit locators, manual detector of 22 kV lines earth faults (ELF7). The paper deals with description of afore mentioned equipment and evaluation of operational experience.

LOKALIZACE ZKRATŮ V SÍTÍCH VYSOKÉHO NAPĚTÍ POMOCÍ MĚŘENÍ V DTS

Jan Souček, Ladislav Pospíchal, Drahomír Pernica, MEgA a.s.,
Milan Jelínek, Jaroslav Kloud, ČEZ Distribuce a.s.

Distribution networks are nowadays commonly equipped with measurement and communication technology on the low-voltage side of the DTS. This metering is mainly used for operational and development purposes and also for power quality assessment. This paper discusses the use of this metering also for operational fault location and in real time. The aim is to identify the affected point in the shortest possible time so that the dispatcher can define the smallest affected section with the first manipulation. There is then no need for unnecessary switching to the fault, as is now common in fault locating. This will reduce the strain on the power elements, reduce the downtime for customers who are outside the faulted area and also give the fault crew in the field more accurate information about the fault location.

The locating system is based on measurements on the low-voltage side of the DTS, but can be supplemented with measurements at the substation or on HV lines in the network to increase accuracy and reliability. The paper discusses the results of a test system developed during a joint pilot project of ČEZ Distribuce, a.s. and MEgA, a.s. in the network near Benešov nad Ploučnicí. The paper discusses the requirements for metering technology, communication superstructure and evaluation system

INNOVATION OF VOLTAGE-FREQUENCY PROTECTION (U-F) ACCORDING TO THE PRESENT PNE 33 3430-8-2 REQUIREMENTS

Jaroslav Pospíšil, Tomáš Effenberger, Protection & Consulting, s.r.o.

Required innovation of voltage-frequency protection are based mainly on work standard for power industry – PNE 33 3430-8-2 CZ 18.2, Clause 4.9.3 and specifically from Sub-clause 4.9.3.4 which specifies 10-minutes RMS. RMS calculation shall correspond to the 10-minute aggregation for S class (according to the EN 61000-4-30) each three seconds and it is evaluated against the Ur set value.

Innovation applies to undervoltage ride-through (Clause 4.5.3 for synchronous and non-synchronous generating technology) and overvoltage ride-through (Clause 4.5.4).

The paper includes the brief description of given protection characteristics for synchronous and asynchronous generation modules of type A and B for LV/MV/HV networks.

UNBALANCE IN THREE-PHASE NETWORK MODEL

Karel Máslo, ČEPS, a.s.
Jan Koudelka, Branislav Bátora, Petr Toman, VUT v Brně

The paper deals with enhancing the three-phase network model for simulation of unbalanced faults such as unbalanced short-circuits, ground faults and phase interruptions. Enhanced model allows to deals with line unbalance, which is most often caused by line transposing.

Enhanced network model was tested using modified four-node model, which simulated unbalanced faults. Additionally, the paper illustrates the transformer earthing impact on current and voltage during such fault. Results were validated by PSCAD/EMTDC program. Enhanced model will be used mostly to study purpose as well as distribution system analyzing.

Operation

THE OPTIONS OF UTILIZING NUMERICAL NETWORK MODEL AND MEASUREMENT DATA TO INDICATION OF NON-STANDARD STATES

Vít Krčál, David Topolánek, VUT v Brně
Jan Vaculík, EG.D, a.s..

The paper deals with option of utilizing data from distributed measurements in LV network for non-standard states identification. Numerical model of grid network supplemented with geographical data was created for simulation purpose. Using this model, specific nodes are defined, which are specified to installation of distributed measurements and acquisition of actual data. Non-standard states are simulated in such a way so the distribution measurements benefits could be illustrated. This paper goal is to illustrate the distributed measurement capabilities and its suitable placement for early identification of evaluating faults and non-standard operational states.

UTILIZATION OF FAULT PHASE GROUNDING INSTEAD OF RECLOSING WITHIN RESISTANCE GROUNED SYSTEM

David Topolánek, Jaroslava Orságová, Petr Toman, VUT v Brně
Martin Fabián, EG.D, a.s.

The paper provides description of automatic fault phase grounding method, which can be used to improve self-dealing characteristics of short-term single-pole faults without the necessary no voltage period. Practice usage of such method and its analysis is provided as well.

DRAFT OF WORK STANDARD FOR CAPACITANCE GROUND CURRENTS COMPENSATION WITHIN MIDDLE VOLTAGE NETWORK

Jaroslava Orságová, David Topolánek, Petr Toman, VUT v Brně

This paper deals with draft of new work standard that forms operational terms, technical requirements and criteria ensuring the safe and reliable operation of high voltage compensation systems. This work standard defines additional requirements and recommendations associated with safety framework for touch voltage protections in compensation systems defied in CSN EN 50 522 and PNE 33 0000-1. Its goal is to allow the distribution system operators to utilize this safety framework in operation of high

voltage systems with ground capacitance current compensation without the need of confinement of these systems. Work standard purpose is the definition of requirements for selecting and using equipment for capacitance ground current compensation within high voltage networks.

Control

CAPACITY OF NON-FREQUENTIONAL ANCILLARY SERVICES FOR REACTIVE POWER MANAGEMENT OF DISTRIBUTION NETWORK OPERATOR

Filip Reiskup, Michal Jurík, E.ON Distribuce, a.s.
Michal Ptáček, VUT v Brně

The paper provides analysis of reactive power data at supply terminals between transmission system and E.ON Distribuce a.s distribution network. The troublesome network areas regarding the reactive power overflows into transmission system are identified. Maximum available capacity for reactive power management is defined using existing resources connected within given distribution area. The paper deals with designing the optimal compensation equipment that is installed in substation with regard to the price of given non-frequency ancillary service.

PRESENT REQUIREMENTS FOR CONTROL AND MONITOR OF NEW POWER PLANTS IN DS

Karel Procházka, EGC- EnerGoConsult ČB, s.r.o.

The paper deals with present requirements for new sources that are connected to the DS are based on Commission Regulation (EU) 2016/631, which defines the network code for plant connected to power system, Regulation 2017/1485, which defines framing guideline for power transmission system operation, 2017/2195, which defines framing guideline for power balance market in power industry and CSN EN 50549-1 Requirements for generating plants to be connected in parallel with distribution network – Part 1: Connection to LV distribution network – Generating plants up to and including Type B and CSN EN 50549-2 Requirements for generating plants to be connected in parallel with distribution network – Part 2: Connection to MV distribution network – Generating plants up to and including Type B

SESSION 4 – DISTRIBUTED ENERGY RESOURCES AND ELECTRICITY USAGE

Guarantee: František Kysnar, EGC ČB s.r.o.

ASSESSMENT OF MICRO-GENERATION OPERATION

Martin Kašpírek, Zdeněk Horák; EG.D, a.s.

This paper summarizes measurements of more than hundred LV networks that contain micro-generation. The power quality evaluation according to the CSN EN 50 160 is provided as well as analyzation of power flow within network particularly with the respect of supplied active power in relation to the reserved power. Additionally, the methodology for micro-grid connectivity assessment is designed respecting both installed and reserved power.

SHORT-CIRCUIT RATING WITHIN PREDI 22 KV NETWORK, SINCAL CALULATIONS

Aleš Krula, PREdistribuce, a.s.

This paper deals with future development of short-circuit ratings within PREdistribuce 22 kV distribution network. Inputs of this analysis consist of NAP SG outputs, known ASEK CR predictions and known development schedules. Particular inputs are aggregated using specific distribution function to required calculating model. Additionally, various operating modes of PREdi 22 kV network are considered as well as its reliability. Calculation variant of short-circuits provide hints to future dimensioning of each element of 22 kV network regarding the short-circuit durability.

NON-FREQUENCY AUXILIARY SERVICE IN POWER SYSTÉM IN THE CZECH REPUBLIC – EXISTING STATUS, CHANGES AND AIMS

Jiří Ptáček, EGÚ Brno, a.s.

Source structure and associated non-frequency auxiliary services are changing in power system in the Czech Republic. Development of source availability regarding the voltage and reactive power control is progressing, associated with middle- and long-term prospect of increasing penetration of decentralized, renewable and non-carbon sources. Numerous measures are already discussed and prepared though there are big challenges regarding the ambitious scenarios of RES development.

ANALYSATION OF REACTIVE POWER IN DISTRIBUTION SYSTÉM AND REACTIVE ENERGY FLOW BETWEEN DISTRIBUTION AND TRANSMISSION SYSTEM

Miroslav Jalec, Západoslovenská distribučná, a.s.

Development and trends of voltage ratings within transmission system for last couple of years show the fundamental impacts of distribution systems, including their users, on variation and increase of reactive energy flow within power system. The paper deals with these reactive power flows within each voltage level, analyzes their occurrence and defines possible mitigation measures.

U/Q REGULATION IMPACTS ON 22 KV NETWORK OPERATION

Milan Krátký, Jan Jiřička EG.D

This paper describes existing practice of distributed energy resources U/Q regulation at 22 kV system operated by EG.D. Regulation reactive power and energy balance is evaluated for each part of distribution system including its relationship with transmission system. The risks of widely applied U/Q

regulation at LV and MV level as well as prospects are discussed. The modification of U/Q regulation deployment is introduced so the regulation system could be sustained in future

FAST DECENTRALIZED SYSTEM FOR VOLTAGE AND REACTIVE POWER FLOW MANAGEMENT IN MV NETWORKS – DSO PILOT PROJECT

Josef Hrouda, František Kysnar, Ondřej Novotný, EGC – EnerGoConsult ČB s.r.o.
Jan Švec, ČEZ Distribuce, a.s.

This paper deals with introduction of decentralized method of voltage and reactive power flow management in MV distribution network. The paper includes description of system fundamentals associated with existing and future requirements of MV supply areas regarding the voltage and reactive power flow management at HV/MV boundary. Experience from pilot project within DSO operation is presented.

SPLIT OF EUROPEAN INTERCONNECTED POWER SYSTEM RESULTING FROM FAILURE IN CROATIA IN JANUARY 2021

Jiří Ptáček, EGÚ Brno, a.s.

In 8th January 2021, major failure in 400 kV Emestinovo in Croatia caused the splitting of interconnected European power system and resulted in the need for countermeasures that prevent spreading the failure. Thanks to the robustness of European power system as well as effective reaction of system operators, the problem was solved within an hour and interconnected operation was restored throughout the whole synchronous area.

DYNAMIC MODELS OF NONSYNCHRONOUS GENERATION MODULES FOR DEVELOPMENT AND READINESS OF TRANSMISSION SYSTEM

Karel Máslo, ČEPS, a.s.

According to the Eu Commision Regulation 2016/631, which defines netowrk code for power system connection requirements, the power generation owners shall provide the simulation models to given system operator, proving the behaviour of generating modules type C and type D during trnasient electromechanical events. These models should be validated through evealuation with conformance tests of this regulation. Consequently, system operators utilize these models to dynamic calculations of (phase angle, voltage and frequency) stability, which affect the development and planned operation in dispatcher simulations. This paper deals with such calculation models, including parameter description and calculation cases.

WIND GENERATION AND SOLAR POWER PLANTS DEPLOYMENT – ANNEX 4, NETWORK CODE PART 12 REQUIREMENTS

Jaroslav Pospíšil – Protection & Consulting, s.r.o.

The first parallel connection electricity generation plants to the distribution system is discussed from the point of view of confirmation of the professional company implementing the construction of the plant, the

agreed project documentation updated according to the actual state of the plant design, the initial inspection report according to ČSN 332000-6-61, ČSN 331500, the protocol on the setting of protections, local operating regulations, including the equipment of the substation with safety equipment and protective equipment and trained operators with the appropriate qualifications according to ČSN 343100 and Decree No. 50/1978 Coll.

The distribution system operator / PDS / shall be entitled to carry out, or require to be carried out, a functional test of the protections in accordance with Part 8, either under actual conditions or by simulation using appropriate test equipment, at the first parallel connection to the network.

PRELIMINARY OF NEW GENERATION MODULES AND REFIT OF EXISTING

Petr Kalandra, ELPAK Praha, spol. s r.o.

The paper describes the work with PPDS and connection conditions issued by the distributor for a given project in relation to other external links that must be respected in the technical design and solution – technological possibilities of the plant, requirements of building authorities, requirements of the environmental department, requirements of the basin for hydropower plants, etc.

There is also a reference to the measurement of production and the measurement of the individual shares of own consumption for the aid statement in relation to compliance with the requirements of laws and directives.

Finally, the paper presents a selection of experiences from the testing of production modules and hydropower plants, demonstrating their technical characteristics.

SESSION 5: DISTRIBUTION SYSTEM DEVELOPMENT

Guarantee: Jaroslav Šabata, EGÚ Brno, a.s.

UTILIZING OF SUPPLY POINT MEASUREMENT PROFILE FOR DISTRIBUTION SYSTEM DESIGN

Vojtěch Jelenecký, PREdistribuce, a.s.

This paper describes the utilization of measured power profiles from smart measurement pilot and B-billing measurement for distribution system design. The proposed methodology provides the calculated specific powers and contemporary consumptions. Methodology is widely applicable thanks to its simplicity and robustness and it supports data update since time series are updated continuously.

UTILIZATION OF DATA STORAGE AND ENHANCE ANALYTICS BY ČEZ DISTRIBUCE A. S. ASSET MANAGEMENT SYSTEM

Adam Teringl, Jan Kůla, ČEZ Distribuce, a. s., Libor Kozubík, IBM Česká republika

This paper deals with implementation of asset management system including the business intelligence data storage in distribution utility.

The paper describes three different parts of asset management system – Asset Performance Management, which analyzes asset reliability based on DEMU method; Asset Investment Planning for strategic investment simulation and what-if analysis; unified background for power asset management and development staff systematic support. The paper deals with IBM SPSS tools with enhance analytics, degradation profile calculation of various equipment, dynamic maintenance intervals based on data storage (base of knowledge). The external system supplier view of implementing the AMS into distribution utility is included as well.

ZKUŠENOSTI S NÁSTROJEM PRIOTOOL PRO PRIORITIZACI OBNOVY DISTRIBUČNÍ SÍTĚ A JEHO DALŠÍ ROZVOJ

Martin Hejhal, Martin Lískovec, Zbyněk Brettschneider, Radek Hanuš, PREdistribuce, a. s.

In PREdistribuce, a. s., an in-house software tool (PRIOTOOL) was implemented to optimize the management and renewal of the distribution network. This paper briefly focuses on the evaluation of up to now experience with PRIOTOOL usage during incorporating HV cables to retrofit and the benefits resulting from its deployment that are associated with the network management regarding with fault localization in the HV cable network, which are the first areas where this software has been deployed. The main part of the paper is then devoted to the extension of the PRIOTOOL SW tool to other segments of the PREdistribution network, namely the prioritization of the restoration of switching stations in the HV feeder network, distribution stations in the HV distribution network and the inclusion of LV cables in the restoration.

PRACTICAL IMPACT OF SDOK INSTALLATION TO OVERHEAD MV LINES

Jakub Nedoma, Petr Špičák, EG.D, a.s., Michal Ptáček, Vysoké učení technické v Brně

The paper deals with changes in the approach to the processing of project documentation of outdoor VN lines with self-support dielectric optical cables (SDOK), which are modern means of strengthening the communication infrastructure at the VN level. These changes stem from mechanical differences between them and conventional AlFe ropes. Their impact is the need to calculate the longitudinal profile of the outdoor line route and its subsequent optimization in the form of correct selection of the initial stress of the SDOK, mutual position with phase conductors and possible installation of the "4-conductor" console, or oversizing of existing support points. These facts resulting in both increased demands on designers and the time required to create project documentation including increasing financial costs for the implementation of these buildings as a result of necessary construction modifications of existing lines and solutions for public or property relations. The main goal of the paper is to present a comprehensive technical design of the installation of SDOK for a specific overhead MV line including its naming and evaluation of engineering/economic impacts associated with SDOK installation.

BPL COMMUNICATION TECHNOLOGY TESTING WITHIN HIGH VOLTAGE NETWORK

Radim Štolfa, Pavel Glac, Martin Vycpálek, PREdistribuce, a.s., Michal Bejček, Pražská energetika

Smart transformer station communication and control method during loss of mains is fundamental for minimizing the no voltage period. Hence the PREdistribuce tested the smart transformer station communication concept, which is independent on backup systems of cell phone operator and utilizes the inherited communication infrastructure instead. Pilot project was implemented in the area of Roztoky u Prahy, where 15 transformer stations communicated through power lines, including 6 smart ones. BPL combined with LTE and fiber optic network in end points was used because it supports fast communication.

PROBABILITY APPROACH TO DETERMINATION OF FAILURE IMPACTS ON 110 KV NETWORK

Zbyněk Brettschneider, Aleš Krula, PREdistribuce, a.s.

The importance of probability calculations and their application is increasing. This is the direct result of digital information that is stored in databases. This data can be utilized to analysis calculations regarding the network development, retrofit or design. Another reason for increasing utilization of probability calculations is new trends such as DECE, e-mobility or AMM, which complicates the load/generation prediction within the network.

This paper deals with determination of failure impacts on the HV network at the given network equipment. Network impacts interpretation is qualified as loss probability of supply power. Failure probability of each HV equipment represents the input for the calculation. The calculation utilizes the admittance matrix of specific network state for determining the network post-failure topology.

SMART METERING DATA ANALYSIS – BENEFITS FOR USERS AND DISTRIBUTOR

Denisa Bajánková, Jan Klimeš, EG.D, a.s., Tomáš Lancinger, BigHub s.r.o.

Digitalization of point of consumption offers new opportunities for both associated parties. Users can get personalized offers for load optimization, service setting or ancillary services with added value. Distributer is able to improve the prediction of load as well as non-technical losses detection. The paper deals with benefits of enhanced analysis and overviews the development and expected prospects from E.ON point of view.

PŘEDSTAVENÍ STUDIE "LOAD MODELLING AND DISTRIBUTION PLANNING IN THE ERA OF ELECTRIC MOBILITY"

Vojtěch Jelenecký, PREdistribuce, a.s.,
Daniel Kouba, EG.D, a.s.

To limit CO2 emissions, many countries announced ambitious targets for the development of e-mobility (electric cars, buses, etc). The charging of these vehicles will create new loads with very specific characteristics and could have a significant impact on distribution networks if the loads are not carefully managed. Smart charging solutions will be designed to minimize network congestions and limit reinforcement costs.

Hence, charging of Electric Vehicles (EVs) in an efficient and economical way will present new challengesfor Distribution Grid Planning.

SESSION 6: MANAGEMENT, ORGANIZATION, QUALIFICATION

Guarantee: Martin Schneider, PREměření, a.s.

EV READY LAMP CONCEPT

Jiří Ullrich, PREdistribuce, a.s..

The paper deals with description of ready lamp EV (Electric Vehicle) concept, which emerged as support for creating point of connection of recharge stations to come. The paper describes the network elements that are used, methods of connection and operation. Experience from pilot test within the Prague area is provided as well description of development and benefits of this solution.

AMM ROLLOUT - SYNERGIE WITH MV AND LV CABLE NETWORK RECONSTRUCTION

Zbyněk Brettschneider, PREdistribuce, a.s.

The paper deals with the impact of AMM development on PREdistribuce a.s. MV and LV cable network reconstruction. The network reconstruction shall take into account the fact that cable is not only use for power supply anymore but it plays significant role as an communication infrastructure.

SYSTEM STABILITY IN THE CZECH REPUBLIC AND THE GREEN DEAL

Hynek Beran a kol.
Cygni, s.r.o. a CIIRC ČVUT

In previous lectures since 2016, we have pointed out that the concept of stability of the electricity system of the Czech Republic (ES CR) based on monopolization of flexibility on coal resources and their "forced export" with limiting decentral regulation and regulation of consumption is short-sighted. The current situation in the European Union, the price of emission allowances and new trends in European energy policy confirm this. So what are the Czech Republic's options?

E-VEHICLE RECHARGING STATIONS – SMART CHARGING A VEHICLE-TO-GRID

Petr Mlýnek, Radek Fujdiak, Jan Sláčik, Lukáš Beneš, VUT v Brně,
Daniel Juřík, Petr Marvan, AIS spol. s r.o.

The paper deals with the issues of recharging stations for e-vehicles and methods of recharge station control focusing on communication and cyber security. Additionally, it discusses smart charging schemes, particularly Vehicle to grid (V2G).

IOT COMMUNICATION TECHNOLOGY FOR SMART METERING AND SELECTIVE ROLL-OUT – REAL PRACTICE OR DISTANT FUTURE?

Petr Mlýnek, Pavel Mašek, Radek Fujdiak, VUT v Brně, Dominik Harman, EG.D, a.s.

The paper deals with analyzation of wireless communication technologies that are suitable for smart metering and selective installation. Theory is validated by real measurements in particular areas with terminal signal level i.e. “deep indoor” for both the designed prototypes and real wireless meters as well.

UTILIZATION OF BATTERY STORAGE FOR FLEXIBILITY

Ivan Trup, MicroStep - HDO s.r.o.

E-MOBILITY AND POWER INDUSTRY

Jiří Berman, Hitachi Energy Czech Republic s.r.o.

The paper illustrates the impact of e-vehicle recharging on power industry. It becomes obvious that the volume of electric energy is not so important as is consider nowadays but the main issue is the contemporary e-vehicle recharging for both slow (nighttime) and fast (daytime) mode. In the case of the Czech Republic, the recharging power is equal to the existing consumption during the winter. The paper deals with feasible mass-produced car that utilizes hybrid propulsion with no need for network recharging. The issues associated with CO2 are discussed as well.

THE METHOD OF PLC CONCENTRATOR CONNECTION TO THE OPTICAL FIBER COMMUNICATION INFRASTRUCTURE

Vojtěch Šimončík, Jan Poslušný, Martin Vycpálek, PREdistribuce a.s.

Regarding the increasing requirements for volume, form and security of AMM data and their transmission to the data center as well as to the customer, the AMM pilot was initiated within the PREdistribuce a.s. The data are acquired from PC concentrator (G3 PLC standard) and transmitted to the data center through optical fiber. Communication network uses passive optical network (PON) and active GPON. The paper introduces the concept and network topology, optical fiber connection to the apartment houses including the connection of optical fiber to concentrator.

MEASURING OF ENVIRONMENTAL IMPACT ON PLC

Ladislav Karlovský, Vojtěch Šimončík, Jan Poslušný, PREdistribuce a.s.

Using PLC for implementation of smart grids and AMM is profitable but introduces some issues as well. These issues are particularly associated with the environmental impacts on such technology. The paper describes the implementation of PLC G3 within various areas with different population density, the environment impacts on communication regarding the long-term measurement as well as

countermeasures for mitigating these impacts. The paper deals with options and benefits of usage various frequency bands for communication and data acquisition from meters.