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20th CONFERENCE OF THE CZECH COMMITTEE OF CIRED

ABSTRACT BOOK

8th - 9th November 2016

Hotel Dvořák - Kotnov - TÁBOR

CONFERENCE PARTNERS:



SESSION 1 – NETWORK COMPONENTS

Guarantee: Karel Kohout, CEZ Distribuční služby, s.r.o.

OPTIONS OF CALCULATING MODEL TOOLS FOR ANALYZING THE EMERGENCY SWITCHING

Vladimír Vajnar, Jana Jiříčková, Jan Sedláček, Faculty of Electrical Engineering, University of West Bohemia

As the gradual development and partial changes are introduced into power system operations the conditions for tripping of operational or short-circuit currents are changing as well. This paper deals theoretically and practically with switching of small capacitance currents and using modelling tools for determining critical areas of arcing chamber. Results are based on functions supported by software tools solving the partial equations using finite element method or finite volume method. These tools are used for analyzing of physical field in arcing chamber of breaker during specific switching like tripping of small capacitance currents.

THE REASONS FOR TESTING IN INDEPENDENT LABORATORIES

Robert Jech, Zkušebnictví, a.s.

This paper deals with the testing basics of different equipment for transmission and distribution system under the simulation of real faults conditions. The emphasis is placed on checking of equipment functions under short-circuit conditions and during overvoltage as well as evaluation how testing under realistic conditions increases the reliability and security of power networks.

Additionally the paper deals with differences between equipment certification based on real testing and so called “paper certification”. These differences are supported by test results statistics of each equipment tested in our laboratories. Several pictures taken during some of the test are presented to illustrate real effects of short-circuit currents.

TESTING OF COMPACT MV/LV STATIONS UNDER THE NEW VALID DIRECTIONS

Milan Kloubec, ELTRAF, a.s.; Roman Kloubec, AZ Elektrostav, a.s.

Modern MV/LV compact stations are, due to their small dimensions, installed in dense municipal areas as well as industry premises. When not properly designed and manufactured, the failure of these transformer stations presents hazard to the staff and public community, particularly in the case of random short-circuit in MV switchboard. Hence there is increasing importance of testing the safety of these stations. Last updates of standards and related directions tighten up requirements for testing of MV switchboards with steel covers and MV/LV compact stations.



BREAKER DIAGNOSTICS IN GAS INSULATED MV SWITCHBOARDS

Václav Straka, Antonín Krňoul, "TMV SS" spol. s r.o.

There is massive increase of GIS switchboard (insulated with SF6) installations in last years. Their main advantage is their small dimensions but very limited options for diagnostics need to be taken into account. That limitation complicated integration of such devices into diagnostics and service life management based on real status. Particularly when they are equipped with a breaker. This paper describes the measurement procedure of MV breaker installed in such switchboards. Methods and connections are described as well as interpretation of measured values.

PROJECT OF MEASUREMENT IN DISTRIBUTION TRANSFORMER STATION (DTS)

Jan Berka, ČEZ Distribuce, a.s.

The CEZ Distribuce has started the project which deals with extent, pattern and options for supplementing of measurements in DTS in relationship with SG NAP. This paper offers full information of 1st stage of this project – terminal DTS.

STATUS INDICATION OF FUSES IN LV DISTRIBUTION NETWORKS

Jan Souček, Martin Paar, MEgA, a.s.

Present development of LV distribution network aims on improvement of network status information. Using of measuring instruments is not always effective particularly at the LV, so the use of indicating elements can be suitable option or addition to existing measuring systems. Checking the fuse status is one the cases where the indication is very effective tool. This paper describes using of indication instruments in the LV networks from the view-point of operation and maintenance of LV distribution networks.

EXPERIENCE OF PRE DISTRIBUCE A.S. WITH NEW CABLE TYPE 1-AYKY-J-OT

Jaroslav Trojan, Jiří Ullrich, PREdistribuce, a.s.

This paper describes the possible way of communication network (optical fibers) implementation within PREdistribuce a.s. distribution network particularly at 1 kV voltage level. It is focused on low voltage cable of 1-AYKY-J-OT type with polymer tube used for subsequent micro-cable installation. Additionally the paper describes the usage and real experience from PREdistribuce a.s. network operations, including blowing the micro-cable between each DTS.

SUPPORTING COMPOSITE INSULATORS FOR MV DISTRIBUTION NETWORKS

Petr Lehký, EGÚ Brno, Stanislav Bartoš, DRIBO

This paper describes the development and possible solution of top part of composite supporting insulators for MV distribution networks. It summarizes the results of mechanical tests regarding to static, dynamic and cyclic stress used during testing of characteristics of post and top terminals of ceramic insulators.



STRAY CURRENT VS. CONCRETE CONSTRUCTIONS

František Rajský, ČEZ Distribuce, a.s.

This paper describes the stray current effect on reinforced concrete improved with chemicals. Special part deals with how the chemical additions for concrete affect the stray current flow through the concrete construction.

EXPERIENCE FROM CIRED CONFERENCE IN SLOVENIA AND CROATIA

František Vybíralík

Information from conference of Slovenian and Croatian CIRED Committee. This paper involves selected experience from reports listed within Session 1 and related to power stations, overhead lines and cables.

SESSION 2 – POWER QUALITY AND EMC

Guarantee: Pavel Santarius, VŠB-TU Ostrava

IMPACT OF NUMBER OF NON-LINEAR APPLIANCES CONNECTION ON POWER QUALITY IN POWER NETWORKS, PART II

Václav Kůs, ZČU v Plzni, Jiří Duspiva, ČEZ - pracoviště Plzeň

This is a second part of evaluation of harmonic currents and voltages in LV networks used in housing estates. It is connected with measurements performed in panel buildings in housing estates. This part documented the result of measurements and harmonic analysis of housing estates consisting of family houses in typical suburb areas. The measurement was taken over a week period. The measurement was made simultaneously at one delivery point and on secondary part of supply transformer. Another specific feature is the length of 22 kV line, which is 9 km.

TESTING OF POWER QUALITY ANALYZER BASED ON REQUIREMENTS OF IEC 62586-2 STANDARD

Martin Šíra (ČMI), Věra Nováková Zachovalová (ČMI), Jan Souček (MEgA, a.s.)

This paper describes standard package for testing of power quality analyzers and implemented measuring algorithms defined by IEC 61000-4-30 ed.3. It focuses mainly on the tests for Class A analyzers and on generating and checking of special voltage signals with time stamps and time synchronization defined by IEC 62586-2.

HISTORICAL VIEW ON POWER QUALITY

Pavel Kraják, ČENES, z.s.

Historical overview of power quality from “41/1883 direction of Board of Trade” until today.



VOLTAGE EVENTS ANALYSIS IN DISTRIBUTION SYSTEM

Miloslava Tesařová, ZČU v Plzni; Martin Kašpírek, E.ON Česká republika, s.r.o

This paper summarizes long-term monitoring of short-term voltage dips, interruptions and swells on each voltage level of distribution network. The results of monitoring provide information about the number and distribution of dips, interruptions and swells on each voltage level during several years. It provides the analysis of dips allocation in distribution network using the simultaneous measurements on 110 kV, 220 kV and 0.4 kV levels in the given area of interest.

EVALUATION OF OPERATION FOR WIND PLANTS CONNECTED TO 22 KV DISTRIBUTION NETWORK

Miloslava Tesařová, Roman Vykuka, Západočeská univerzita v Plzni, Martin Kašpírek, E.ON Česká republika, s.r.o.

This paper summarizes results of temporary (weekly) measurements of wind plants connected into E.ON Distribuce MV distribution network. It contains measurements and evaluation of all power quality parameters based on CSN EN 50 160 standard and it analyzes the wind plants operation impacts particularly on flicker and voltage level. Additionally the paper evaluates wind plants operations regarding the operational values of reactive power and power factor. For example it analyzes also the annual energy production of wind plants in MWh and compares it to production of one MW photovoltaic plant.

EVALUATION OF OPERATION FOR WIND PLANTS CONNECTED TO 22 KV DISTRIBUTION NETWORK

Martin Kašpírek, Jan Jiříčka, Ladislav Mikuláš; E.ON Česká republika, s.r.o.

This paper evaluates results of measuring campaign executed in LV networks with incorporated DER (photovoltaics). The measurements were executed in thirty different distribution networks in 2016, simultaneously at both supply transformer station and plant's point of connection. Thus there were sixty measurements with one week period evaluated on CSN EN 50160 basis regarding the related parameters (voltage variations, flicker, unbalance, harmonic distortion and selected harmonic voltages). The paper analyzes the impact of plants, particularly the voltage variations as well as power flow in network in general.

METHODS OF MEASUREMENT AND ANALYSIS OF SYMMETRICAL DISTURBANCES IN DS WITHIN FREQUENCY RANGE 2(9) – 150 KHZ

Jiří Drápela, Tomáš Doseděl, Ústav elektroenergetiky, FEKT, Vysoké učení technické v Brně

This paper focuses on possibilities of measurement and analysis of symmetrical disturbances in frequency range from 2 kHz to 150 kHz. These are not problem of power quality nor electromagnetic interference (EMI) but they still can cause severe malfunction of wide range of devices and appliances. This paper deals with whole measuring system from sensors with necessary sensitivity, frequency and time resolution to long-term monitoring.

LONG-TERM MONITORING OF SELECTED QUALITY PARAMETERS IN DS

Petr Krejčí, Pavel Santarius, Richard Velička, FEI TU Ostrava, Zdeněk Brunclík, ČEZ Distribuce

This paper summarizes results of long-term monitoring (from 1997 to 2012) of selected power quality parameters (flicker, harmonics, unbalances) in CEZ distribution network in the North Moravia region. The monitoring was performed at 59 points of distribution network at each voltage level (HV, MV and LV). Basic results and trends of changes are evaluated. Monitoring and evaluation was compliant with CSN EN 50 160 standard.

VOLTAGE – PRESENT AND FUTURE

Zdeněk Hruška, ČEPS, a.s.

This paper deals with evaluation of present status of reactive power generation in power system and its impact on the each voltage level voltage. The paper evaluates possible development in that area and possible development of reactive power compensation and decompensation in system, with regard to external and internal impacts in power energy.

PRESENT POWER QUALITY AT SPECIFIC POINT IN CZECH REPUBLIC

Jan Petrásek, František Kysnar, EGC – EnerGoConsult ČB, s.r.o.

This paper provides the information of present level of power quality parameters at specific points in DS in area covered by all three DSOs. Evaluation of permanent data monitoring include power quality at points of connection between TS and DS, at point of consumption at 110 kV and in 110 kV/MV supply stations. The paper includes the level of coherent phenomenon, but partially it deals with number of voltage phenomenon statistics as well.

SESSION 3: OPERATION, CONTROL AND PROTECTION

Garant: Petr Toman, VUT Brno

Operation

GROUND FAULT LOCALIZATION IN 22 KV NETWORK USING HANDHELD MEASURING INSTRUMENT

Martin Horák, Miroslav Jalec, Západoslovenská distribuční, a.s.

The issue of local ground fault detection has been subjected by many studies in last several years but functionality of stationary installed systems in real operation is questionable at best and there are almost zero operational results available. Handheld measuring instrument offers a variant to the stationary installed systems and it provides the staff with the ability to localize the ground fault in reference to the point of measurement. This paper contains the description of function and options of handheld measuring instrument as well as data measured during “localization” of experimental ground faults in 22 kV network.

NEW METHOD OF GROUND FAULT IDENTIFICATION AT MV LINE

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

This paper presents the relays used for indication of ground faults at MV networks basics, analyzation of each earth protection sensitivity (for I0 component, admittance, conductance and directional) regarding the distributed power generation (water, wind and cogeneration power plants and photovoltaics).

In the phase of draft standard PNE 38 40 65 we recommend to focus individual articles to the issue of ground faults – earth relays, as well as to primary tests of earth relays and to automatic switching a resistor in MV networks.

The paper contains new procedure of ground fault localization through time synchronization of measured currents I0 throughout MV line.

CABLE INSERTED INTO HV LINE – PROTECTION AND SHORT-CIRCUIT LOCALIZATION

Jiří Bermann, ABB s.r.o.

25 to 30 years ago, former Czech Power Dispatching proposed separated cable and overhead lines for the newly built 110 kV cable network in Prague. The aim was improving the cleanness and lucidity of the network, as well as protection, thus improving reliability, lowering losses etc. So the cable 110 kV network in Malešice area was created. However this concept was not followed and not only mixed networks were created but moreover there appeared requirements for cable incorporation into overhead lines.

This paper describes not only the issues of protection of such combined lines and deterioration of short-circuit localization but also shows the inability to determine whether a short circuit is inside or outside the cable.

POSSIBLE WAYS OF LOCATERS IMPROVEMENTS IN 110 KV LINES

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

Number of researches and scientific or technical tasks are aimed at elimination of errors of distance relay locaters nowadays. Thus this issue is relatively well documented and published. The solutions are so far based on synchronous measurements of fault currents and voltages on both terminals of protected line. Currently there are devices allowing for synchronous measurements of desired values in system and their transfer to the center. But most of the state of art distance relay locaters for 110 kV line use the measurement of voltages and currents at the begin of protected line for impedance determination of line leading to fault. This paper describes the reasons of errors in fault distance determination of such locaters and deals with possible methods eliminating these errors.

IDENTIFICATION OF ISLANDS IN NETWORKS WITH RENEWABLE SOURCES

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

This paper deals with island operation issues in networks containing renewable sources, with selectivity of multi-functional electric relay used against LOM (Loss Of Mains) type of island operation.



Such functions can be utilized e.g. in industrial objects with generating unit installations. The island detection is one of the basic prerequisites of correct connection into network containing renewable sources. LOM relays work on passive basis (monitoring network parameters – frequency, voltage, phase angle), active basis (measuring of impedance during small voltage variations at point of connection, step changes of frequency) or used remote identification in the case there are suitable terminals available, which conform with IEC 62786 standard requirements for connectivity of renewable sources.

PROTECTION OF SMALL POWER SOURCES CONNECTED INTO DISTRIBUTION SYSTEM

Jan Gala, ABB, s.r.o.

This paper deals with utilization of new protective functions in deregulated power market with special regard to renewable energy sources. These RES are often connected into the distribution networks or they are part of smaller usually industrial blocks and participate on local consumption. Ongoing sources distribution in power system changes the perspective and convention for system management and new functions protecting these sources can be adjusted to this new status thus provide the best possible protection of these sources as well as close appliances.

TITLE: SWITCHING OVERVOLTAGE OF HIGH-VOLTAGE BREAKERS

Jan Pígl, Eaton Elektrotechnika s.r.o.

Switching over-voltages of high-voltage breakers are known for many years. Though this phenomenon is well known the electrical devices of distribution system are repeatedly damaged due these over-voltages. This paper is aimed at explanation of conditions under which these over-voltages are generated as a result of switching of high-voltage breakers. This paper discusses the procedures reducing the overvoltage in cases when it is dangerous for given device.

PROBABILITY APPROACH FOR EVALUATING OF EARTHING SYSTEMS USED IN DISTRIBUTION NETWORKS

David Topolánek, Václav Vyčítal, Petr Toman, VUT v Brně

This paper aims at implementation of probability approach for evaluating of earthing system security into valid procedures defined by CSN EN 50 522 standard so they could be used in European distribution systems. The paper contains draft of procedure for evaluating of earthing system security explained on the example of testing distribution transformer station including calculated and evaluated death probability. Final part of paper deals with sensibility analysis of input data pinpointing possible shortcomings of similar approaches.



FAULT CURRENTS AND PROTECTION AGAINST TOUCH VOLTAGE IN MICROGRIDS

Karel Procházka, EGC-EnerGoConsult CB s.r.o., Pavel Kraják, ČENES Praha

This paper gives information of live topic, the so called microgrids, presenting basic requirements for safety operations regarding touch voltages as well as basic necessary evaluation for model grid with generations and loads – calculation of power flow during normal operation, during starting up the motors and under the short circuit conditions. The evaluation is considered for shunt operation of microgrid with network as well as during island operation.

Operation

FUNCTIONS VERIFICATION OF OPERATIONAL PROCEDURES OF SHUNTING IN REAL OPERATION

Ivan Cimbolinec, Jan Švec, Jakub Ehrenberger (ČVUT v Praze, FEL)

Continuing increase of capacitive currents in compensated middle voltage networks causes considerable problems to DSOs. The main issue is critical magnitude of active non-compensated component of fault earth current causing permanent arcing during ground faults. This paper describes and evaluates the improvement and effectiveness of known shunting methods on the basis of real measurements taken during ground faults in compensated MV networks.

LOSSES IN HV AND MV CABLES SHIELD AND METHODS OF THEIR ELIMINATION

Radek Hanuš, PREdistribuce, a.s.

Petr Beneš, Com – Pakt Energy, a.s.

This paper describes the methods for calculation of losses in cable shields during the design stage. There is a detailed description of each factor affecting the losses in cable shield. This paper describes relevant means for decreasing losses in cable shield including calculation effectiveness of such means. The comparison between calculated and measured values was done for selected applications.

Control

ICS CYBER SECURITY

Petr Denmark, PREdistribuce, a.s.

This papers deals with ICS (Industrial Control System) cyber security in the power industry. Regarding the new cyber security law and its statutory instruments many operators of such mostly specific systems would deal with range of challenging issues during relatively short transition period.



Solving these issues and filling all requirements will request significant investments into resources (workers, time and money) as well as close cooperation with producers and vendors of these systems and with developers of HW components used for current controlling and SCADA systems.

ADVANCED COMMUNICATION TECHNOLOGIES AND CYBER SECURITY OF SMART GRIDS IN POWER INDUSTRY

**Petr Mlýnek, Radek Fajdiak, Ondřej Krajsa, Kryštof Zeman, VUT v Brně
Ladislav Pospíchal, Pavel Kubíček, Jiří Babka, MEgA - Měřicí Energetické Aparáty, a.s.**

The main challenge of effective Smart Grid development is the communication technology advance and selection of suitable data channels or backbone networks for different operational areas. The existing pilots clearly show that the selection of suitable communication technologies is fundamental for future development of Smart Grids.

Cyber security is another main issue of Smart Grids development since it protects increasing number of devices and their communication channels against increasing range of threats.

This paper describes these two main issues through analyzation of pilot measurements.

COMMUNICATION TECHNOLOGY FOR SPECIFIC SMART GRID AREAS AND GRID OPERATION

**Petr Mlýnek, Radek Fajdiak, Pavel Mašek, Jiří Hošek, VUT v Brně
Jiří Pařízek, Juan J. Zamphirolos, Jan Vaculík, E.ON česká republika, s.r.o.**

The Internet of Things (IoT) represents the fast developing system consists of many different communication technologies.

This paper introduces communication technologies supporting M2M (machine-to-machine) data transfer particularly 4G mobile networks – LTE (Long Term Evolution). Another one is the LPWAN (Low-Power Wide Area Network) technologies which represent the current state of art in IoT. Additionally the radio communication and PLC are considered as well.

The paper shows the test results of these technologies in specific area being prepared for Smart Grid realizing data acquisition from data concentrators of Smart Metering and connection of distribution transformer stations and switchboards into the grid.

COMMUNICATION AND UTILIZATION OF DATA FROM DISTRIBUTION TRANSFORMER STATIONS

Pavel Glac, Petr Lžičař, PREDistribuce, a.s.

There will be need to establish the communication infrastructure down to the distribution transformer station level due the distribution system requirements caused by numerous reasons such as expected expanse of electrical vehicles recharge structure, distribution of resources, higher requirements for distribution system reliability. This allows their remote control, online monitoring, measurements, tracking of power quality etc. In case of positive evaluation of AMM implementation, most likely the measuring data concentrator will be located here.

Thus distribution transformer stations will provide huge volume of data of different types: station control data, real time indication of status and alarms on one hand and data including time profile of measurements, power quality, load profile of points of consumption on the other hand. This will increase not only communication infrastructure requirements but associated IT support as well.

The simulation of such data flows was made for typical distribution areas of PREdi: downtown, habitation and boundaries of Prague based on type, frequency and expected data volume.

This paper deals with evaluation of supposed data flows depending on expected scenario of automated distribution network development and possible ways of utilizing technological data from distribution stations.

SESSION 4 – DISTRIBUTED ENERGY RESOURCES AND ACTIVE DEMAND INTEGRATION

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

IMPLEMENTATION OF EUROPEAN NETWORK CODES RELATED TO CONNECTION OF NEW GENERATIONS AND LOADS TO POWER SYSTEM

Oldřich Rychlý, ČEPS, a.s.

This paper serves as introduction into the European network codes issues with detailed description of connecting network codes and implementation process. Technical requirements for each class of new generation modules are introduced in more details as well as implementation process regarding the European Commission Direction (EU) 2013/631. Technical requirements for each load type regarding the point of connection are described in context with network code. It contains final dates for implementation process for partial tasks applying for new loads and generations that are common for European network directions.

ELECTRIC WORK MEASUREMENT ACCORDING TO EDICT OF MINISTRY OF INDUSTRY AND TRADE NR. 82/2011

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

This paper deals with current procedures of electric work measurements particularly with data obtained through power measurements in compliance with § 4 and clause (3) according to which the substitute consumption data are calculated in case of provable meter malfunction. The paper contains real case of meter malfunction on the MV side of photovoltaic generation of 1 MW power including analysis of existing solution.



Another example of faulty measurement of electric work is LV side measurements in residence particularly after the lift replacement.

We try to clarify this issue in Distribution Code, Amendment 4.



ANALYSIS OF ENTSO-E RECOMMENDATIONS IMPACT ON REFITTING OF PV FREQUENCY RELAYS IN CZECH REPUBLIC

František Kysnar, Josef Hrouda, Karel Procházka, EGC-EnerGoConsult ČB s.r.o.

Svatopluk Vnouček, Zdeněk Pavlovič, Pavel Černý, Josef Matouš, ČEZ Distribuce, a.s.

This paper focuses on impact of “Dispersed generation impact on Continental Europe region security” ENTSO-E recommendations from 15. 11. 2014 regarding frequency relay retrofit for PV power stations in Czech Republic. It summarizes the reasons leading to global retrofitting of frequency relays and pointed out expected operational technology layouts which need to be met during the frequency relays retrofit.

IMPACT OF Q/U AND P/U PV CHARACTERISTICS ON THE CONNECTABLE POWER IN LV NETWORKS

Josef Hrouda, Karel Procházka, František Kysnar, EGC-EnerGoConsult ČB s.r.o.

This paper deals with autonomous voltage regulation in LV networks using Q/U and P/U inverters. The impact of Q/U and P/U characteristics parametrization on connectivity of PV power within MV/LV distribution station is shown for LV network model. The risks associated with autonomous operation of PV in LV networks were identified based on calculation results.

U/Q REGULATION OF WIND POWER PLANT IN MV NETWORK

Roman Vaněk, ČEZ Distribuce, a.s.

Under the normal conditions, the voltage swell caused by generation shall not be higher than 2 per cent at the point of connection for plants connected into MV and 110 kV network compared with the situation when these plants are not connected.

The evaluation of plant connectivity shall be based on requirement that power factor $\cos \phi = 1$ at delivery point needs to be met. This can be achieved only in case of plants fitted with $PF=f(U)$, $Q=f(U)$ or $P=f(U)$ function.

COOPERATION OF EQUIPMENT PROVIDING U/Q AUXILIARY SERVICES DURING CERTIFICATION TESTS IN KRASIKOV AREA

Jan Šeda, ČEZ Distribuce, a.s.

Compensators were introduced as specific kind of equipment for reactive power correction in transformer station Krasikov area during last couple of years.

Two synchronous machines with range from -50 MVar to 100 MVar connected to the tertiary of EHV/HV transformers have passed several certification tests in order to provide U/Q auxiliary services. This auxiliary service is aimed at supporting the system during solving of local function i.e. holding the voltage in standardized and operational safe values in given area. There is other equipment in Krasikov area that can also provide the auxiliary services. Utilizing of this service is in responsibility of CEPS Inc. staff, particularly staff for operational control.



All these equipment shall be certified in compliance with network code in regular periods. The cooperation with other equipment of auxiliary service providers is needed in preparation and during the tests.

This paper informs about such relationships for each test including examples and presentation of experience from close cooperation during certification test of compensators and other equipment in that area.

INTEGRATION OF RECHARGE STATIONS SUPPORTING STORAGE – OPERATIONAL CHARACTERISTICS

Petr Mastný, Jan Morávek, Michal Vrána, VUT v Brně

This paper deals with EV recharge station issues focusing on operational characteristics of fast recharging station with storage and aims on impact of such station on network at the point of connection. The analysis utilizes simulation model of defined block and measurement from each part of the system.

PRESENT ENERGY INFRASTRUCTURE OF BRNO WITHIN THE FULL ELECTRIC VEHICLE NETWORK

Milan Krátký, Tomáš Mendl, EGÚ Brno, a. s.

Recently the electric vehicle network is the subject of frequent discussion, emotions and myths. The future impact of multitude electric vehicle on power infrastructure is main topic of discussions. This paper shows how the existing infrastructure of Brno would deal with massive electrification of personal transport. It supposes the 100 % replacement of existing cars with combustion engine by EV. It is based on present traffic situation in Brno and different methods of EV recharging.

ANALYSIS OF PV GENERATION AIMING ON COMPARISON OF THEORETICAL CALCULATION AND REAL MEASURED GENERATION WITH EXPECTED MEASUREMENT ERRORS

Jan Petrásek, František Kysnar, EGC-EnerGoConsult ČB s.r.o.

This paper aims at evaluation of theoretical PV generation and measured values at PV's delivery point. The reasons for such complex study consisting of evaluation of theoretical generation and measurements at point of connection in four years were doubts of PV operator about the accuracy of this measurement. The accuracy of procedure for given power plant was compared with other PV station of same operator where PV generation corresponds with the expected utilization of maximum.

THE ISSUE OF INCREASING OF PV PLANT POWER DURING REPLACEMENT OF DAMAGED MODULES

Pavel Tureček, Miroslav Hronek, Protection & Consulting, s.r.o.

This paper deals with issues of PV power plants operation and the reasons for the need of solar panels replacement. It aims at subsequent measurements and evaluation of overall generation of



each module as well as whole blocks and electric installation of implemented technology for energy conversion and distribution which depends on date of installation and environmental conditions.

The measurements results and results from monitoring system are provided for whole period of 1 MW PV operation as well as comparison values from other plants. Not less important is the relationship with valid legislation particularly the energy law amendment n. 131/2015 series revoking law 458/2001 series.

PV IMPACT ON RIPPLE CONTROL SIGNAL IN DS

Tomáš Hanžlík, EGC-EnerGoConsult ČB s.r.o.

Impact assessment of photovoltaics on Ripple Control signal level is usually included in connectivity study required by DSO for every such equipment that would be connected to DS. The assessment is based on PNE 333430-6. Generating equipment connected to the network through static inverters (particularly photovoltaics) do not usually caused the illegal disturbances of Ripple Control signal thus there are no power limits for their network connectivity. Still some real installations prove that the parameters of these plants need to be evaluated as well.

FINDINGS FROM CROATIA CIRED CONFERENCE

František Vybíralík, Linda Vaňková Vybíralíková

The most utilized renewable energy resources in Croatia are wind, PV and biogas plants. This paper describes the pilot project of biogas station supplying power to distribution network and using waste heat for heating of agriculture greenhouse.

EXPERIENCE FROM KRYSTOFOVY HAMRY 21 X 2 MW WIND FARM – VII

Vladimír Velek, ČEZ Distribuce, a.s.

The wind farm in Krystofovy Hamry is fully operational since 1. March 2008. Wind farm measurements, indication and control were incorporated into CEZ Distribution control system – North. Due owner's willingness, the data from commercial measurements are available to the author. This paper summarizes present operational experience and performance statistics of wind farm from 1.March 2008 to 28.February 2016.

3 X 2.3 MW WIND FARM U TRI PANU

Vladimír Velek, ČEZ Distribuce, a.s.

The 3 x 2.3 MW wind farm U Tri Panu is fully operational since 26.October 2006 and related data are available since 2010. This paper features the wind farm operation results and performance statistics for 2015 and overall statistics for 2010 to 2015 period. Additionally, it includes the comparison of performance statistics of Krystofovy Hamry and U Tri Panu wind farms.

SESSION 5: PLANNING OF POWER DISTRIBUTION SYSTEMS

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

EVALUATION OF OPERATIONAL VOLTAGE IN DISTRIBUTION NETWORKS 22 KV AND 0.4 KV

Jan Jiříčka, Martin Kašpírek, E.ON Česká republika, s.r.o.

This paper analyzes operational voltage levels in MV networks from 22 kV substations to the end of MV lines. The comparison of real (measured) voltage level with values anticipated due to the setting of tap changer control unit is based on 161 power quality measurements made on 110/23 kV transformers output. The differences between real and theoretical values are discussed together with verification of real solutions. The evaluation of voltage level at the end of 22 kV lines is based on analysis of 90 power quality measurements made at major consumers and MV plants side. This data are used as basis for optimal voltage level of tap changer control unit and suitable MV/LV transformer ratio.

OPTIONS FOR INCREASING OF COMPENSATING POWER OF MV NETWORKS REGARDING THE EARTH CAPACITANCE CURRENTS AND TOUCH VOLTAGES

Miroslav Jalec, Martin Horák, Západoslovenská distribuční, a.s.

In context with engineering standards update, this paper deals with determination, evaluation and identification of possible options for expanding the 22 kV compensated networks regarding to increasing capacitance currents in connection with requirements on earthing and allowed touch voltages. It provides simple directions for designers of how to select suitable premises for designing earthing systems. The theoretical calculation principles are supplemented by real data from operation of 22 kV distribution system. The final chapter deals with analysis of one real increase of compensation power on real 110/22 kV station basis, including proposed solution.

RECONSTRUCTION OF MV MAIN LINES AND PROVIDING OF STANDBY OPERATIONS

Jan Jiříčka, Daniel Kouba, Jiří Sonka, Radek Robausch, E.ON Distribuce a.s.

This paper provides presentation of real engineering measures in MV network allowing future reconstruction (duplication) of power lines while minimizing the number of customer breakaways. The paper describes the procedures for split MV consumption into several power lines, modification of MV network switching elements and new switchboard installation leading to shunt operation of existing and new power line. The implementation needs to be supported by network calculations for different configuration and provide the recommendation of acceptable alternative. All calculations are checked after installation of every new component and the implementation of standby network operation during planned reconstruction of power line is evaluated.



UAVS AND THEIR POSSIBLE INTEGRATION INTO THE DISTRIBUTION SYSTEM MAINTENANCE

Petr Honsa, Petr Lang, Miloslav Fialka E.ON Česká republika, s.r.o.

This paper deals with questions regarding the UAVs – drones and their possible utilization in HV lines maintenance. In 2015 the project for evaluation of drone contribution was launched and it analyzed existing unmanned systems available on market. The project supposes the procedure and the quality level of documentation of HV poles. Next stages within this subject will be outlined in the final part of the paper.

PRIORITY OF DISTRIBUTION EQUIPMENT RESTORATION THROUGH SOFTWARE TOOLS

Jozef Potoček, Východoslovenská distribučná, a.s.

VSD a.s. utilizes the SAM and MC Engine software tools for cost efficiency, higher transparency and fair-mindedness in development and renewal of equipment, improving of distribution system equipment status and reliability of power distribution. SAM tool serves for distribution system “overview”. Strategic Asset Management (SAM) simulates detrition of asset, reliability of distribution and range of other technical and financial parameters during defined period of time and offers predictions for future. MC Engine tool offers the detailed picture of distribution system and is used for identification and prioritizing sources restoration based on multi-criterion analysis.

DECISION-MAKING PROCESS REGARDING THE EQUIPMENT RESTORATION IN LARGER SENSE

Oto Frič, Ing. Miroslav Saxa, Ivica Bednárová, Peter Kulla, Západoslovenská distribučná, a.s.

The asset management theory features directions and standards that should rule the decision of long-term asset restoration not only in the power industry. Gathering of data for processing as well as decision-making is challenging due long-term life service, amount and spreading of asset. This paper tries to describe asset management issues regarding the prioritizing of equipment restoration based on real world experience. Decision making concerning the need of restoration and determining its priority in time not always depends on evaluation algorithm results.

EVALUATION OF POWER QUALITY FOR 2015

Jan Šefránek, Energetický regulační úřad

This paper deals with power quality evaluation for 2015. It focuses mainly on continuity indicators and associated aspects. Additionally the paper presents quick comparison of achieved power quality level in the Czech Republic and in other countries particularly regarding the CEER's 6th benchmark report on quality of electricity supply.



EVALUATION OF SHORT-TERM INTERRUPTIONS OF POWER SUPPLY – MAIFI

Filip Brož, František Kysnar, Karel Procházka, EGC – EnerGoConsult ČB, s.r.o.

This paper deals with short-term interruptions in CEZ distribution system regarding to various aggregation rules. Additionally it analyzes short-term interruption based on their duration.

STRATEGY OF DTS RENEWAL IN MUNICIPAL DISTRIBUTION NETWORKS

Stanislav Votruba, Zbyněk Brettschneider, PREdistribuce, a.s., Petr Skala, Oto Bucholcer, EGÚ Brno, a.s.

Distribution system resources are refitting based on distribution utilities long-term strategy for each group of equipment. Important group of distribution networks are MV/LV distribution transformer stations. Their refit can be based upon plain restoration or can include advance implementation of modern telemetry and remote control. The selection of specific strategy is comprehensive task that includes determination of contribution of distribution continuity improvements.

This paper outlines possible strategies in cable distribution network, draws evaluation procedures on reliability simulation basis and shows expected effects on selected example.

SOFTWARE SUPPORT FOR CALCULATION OF RELIABILITY AND RELIABILITY INDICATORS

Tadeusz Sikora, Stanislav Rusek, Radomír Goňo, Vladimír Král, Vysoká škola báňská – Technická univerzita Ostrava

This paper aims at calculations of reliability and reliability indicators in distribution networks by the software developed by Institute of Electrical Power Engineering of VSB – Technical University of Ostrava.

CALCULATION OF DISTRIBUTION NETWORK RELIABILITY AND EVALUATION OF SPECIFIC RELIABILITY MEASURES REGARDING TO RELIABILITY AND ECONOMICAL PARAMETERS

Filip Brož, František Kysnar, Karel Procházka, EGC – EnerGoConsult ČB s.r.o.

The benefits of specific DS modifications regarding to SAIFI and SAIDI continuity indicators are shown on the model of distribution network part using the calculation SW.

Specific reliability measures are evaluated in association with continuity indicators as well as from the point of view of investment and operational costs.

SESSION 6: CONTROL, ORGANIZATION, QUALIFICATION

Guarantee: Martin Schneider, PREměření, a.s.

CURRENT SITUATION AND EXPECTED CHANGES IN DISTRIBUTION CODE

Karel Procházka EGC-EnerGoConsult CB

This paper informs on the structure and valid version of Distribution Code as well as expected changes inspired by requirements on ENTSO-E Network Codes implementation which are issued in form of European Commission Directives, particularly (EU) COMMISSION DIRECTIVE 2016/631 from 14. April 2016 identifying the network code requirements for connection of power plants to power system as well as on draft of Load Connectivity Code.

LOCAL DISTRIBUTION SYSTEM OPERATION, RIGHTS AND DUTIES

Pavel Círek, Energetický regulační úřad

In context with decentralization of power industry the options of local distribution system operation become wider. Operators of these distribution systems are often misleading of their rights, duties or concessions defined by valid legislations. This paper deals with most important rights and duties in power industry affecting the operator's day by day decisions. The Energy Regulatory Office activities regarding these operators will be summarized as well.

EXPECTED CHANGES OF ENERGY MIX AND DISTRIBUTED POWER INDUSTRY ROLE

Hynek Beran, ČVUT, Český institut informatiky, robotiky a kybernetiky

Updated State Energy Policy includes continuation of nuclear generation, gradual decreasing of fossil fuel portion, developing of distributed and renewable resources and opening power systems for new solutions. National Action Plan for nuclear power defines three options of finishing of nuclear power plants: CEZ, consortium of foreign stakeholders or Czech government but none of those is ready to do the job at this moment. The prolong service life of Dukovany is the option. In other case there would be a serious and open issue. Whether such deficit could be replaced by distributed generation is matter of argument. The annual balance is not an issue but the hour and sub-hour balance is particularly due disparity in generation and consumption. This paper deals not only with technical, tariffs and regulatory issues as well as how to define the acceptable form of subjects in energetics infrastructure and their motivation for participating on general management and stability of power system.



SMART GRIDS AND INTERNET OF THINGS

Miroslav Hladík, Toshiba

This paper presents the way of next generation Smart Grids development within the concept of IoT and starting the fourth industrial revolution (Industry 4.0). It aims at system integration of measurement, protection, control and switching instruments with sensor technology and new communication and data transfer. It is strongly focusing on applications in power supply, transportation (e-mobility), household and industrial automatization. The strong cloud solutions are superstructure of whole system.

POSSIBILITIES OF PLC COMMUNICATION TECHNOLOGY IN MUNICIPAL ZONE

Martin Vycpálek, PREdistribuce, a.s.

Present experience clearly shows that fast and reliable communication infrastructure will be pivotal for smart grids and AMM implementation. This paper describes the project that aims at verification of narrow- and broad-band power line communication synergy and proving that this technology is able to support sufficient transfer capacity not only for basic AMM functions but even for the future upgrades (e.g. gathering data for balance analysis, measuring of losses or reactive power at LV level etc.).

NETWORK OPTIMIZATION THROUGH AMM TOOLS

Ondřej Mamula, ČVUT

This paper deals with the impact of general use of AMM on the methods of load control at the consumption points. Existing system of Ripple Control utilizes so called broadcast – only the receivers with correct settings are responding to the general broadcasted telegram. Thus these receivers are highly inflexible regarding the different Ripple Control command.

Electricity meter relays are controlled by an individual time program saved in the meter memory and this program can be updated remotely. Thus AMM offers load control for each consumption point which can be very helpful for network stability management.

REQUIREMENTS FOR STATION MEASUREMENT SYSTEM AT LV LEVEL

Pospíchal Ladislav, Mega, a.s.

This paper deals with interconnection of measurement system with information resources of low voltage station, meaning and cost of each function and association with information systems of distribution utilities.

START OF ELECTROMOBILITY IN THE CZECH REPUBLIC?

Adam Čečák, Václav Vodrážka PREměření, PREdistribuce

This paper reacts on changes in support of e-mobility expansion and on other legislative incentives for e-mobility development. Does the change to this kind of propulsion in road transport really occur? The



paper deals with the speed of such transition as well as with the role of power industry in the e-mobility development.

CYBER RISKS IN INDUSTRY: WHAT ARE EXISTING THREATS AND PROCEDURES FOR THEIR ELIMINATION?

Martin Leskovjan, Citadelo

Black Energy Incident / research of methodology for secure development and testing of industrial control systems.

At the beginning of 2016 the Ukrainian distribution system suffered severe security incident that caused interruption of electricity supply for more than 200 000 people. Malware Black Energy became another milestone in cyber security of basic power infrastructure. With progress in Smart Grids and "Industry 4.0" and thus more complex remote control of all key processes and data acquisition the risks in systems cyber security are increasing. How can hackers attack the generation and distribution network? What is the risk of extensive attack against the power system?

CYBER SECURITY MEASURES IN CEZDISTRIBUCE

Michal Andrejčák ABB, ČEZdistribuce

SECURITY OF INDUSTRIAL CONTROL SYSTEMS (ICS) IN REAL WORLD

Martin Leskovjan, Citadelo

The most frequent risks identified by audits; the methods of evaluation of cyber risks; what can be expected from security audits in power industry?

With increasing number of hacking of industrial companies particularly within power industry there is an increasing focus aimed at the security of key control systems because corruption of these systems can cause severe damage to economy or assets or can cause even injury to persons. This paper informs about the experience of real testing of industrial security systems protecting against cyber attacks and revealing alarming situation of IT security in industry. There are various ways of security so the experts will represent possible scenarios of how to ensure the security particularly within the power generation and distribution area.