MEĐUNARODNO REGIONALNO SAVETOVANJE O ELEKTRODISTRIBUTIVNIM MREŽAMA

REGIONAL CONFERENCE AND EXHIBITION ON ELECTRICITY DISTRIBUTION

Crna Gora, Herceg Novi, 5 - 8. oktobar 2004. / ***Montenegro, Herceg Novi, October 5 - 8, 2004***

THE PRACTICAL EXPERIENCES WITH DISCONNECTOR AND RECLOSER INSTALLED IN DISTRIBUTION NETWORK ZDP "ELEKTROKRAJINA" (PILOT PROJECT)

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SUMMARY

This paper gives the record of experience with the equipment installed on 20 kV overhead distribution network in the area of Elektrokrajina, Banjaluka, remotely controlled by radio communication from dispatching center.
The supply of electricity to rural area, under the conditions of modern market oriented business , with the aim of the reduction of operational costs and less interruption in electricity supply to the consumers, was the reason for commissioning of pilot project on 20 kV overhead network in Elektrokrajina , Banjaluka.
The paper describes the advantages of this kind of equipment and the experiences gained from the moment of installation.(May, 2003)

INTRODUCTION

In the overhead distribution networks covering rural areas in the developed countries modern solutions of switchgear, disconnectors and circuit breakers are in use more and more.
The disconnectors for outdoor installation ie. classical pole mounted line disconnectors at selected point, in radially supplied network, have gone, during its "development " through following stages"

- -Original and the version mostly represented in the network is with manual control of the disconnector at the site , under non-energized conditions
- -The next step was equipping of disconnector poles with arc extinguishing chambers which allowed for disconnector control during operation, with energized network.
- -The first step toward automation of disconnector operation was when disconnector was equipped with adequate condenser and electronic assembly which was adjusted with automatic reclosing in supplying SS110/x kV.
  In this way , it was possible to have self-switching off disconnector during nonenergized status (so called "intelligent " disconnectors)
- -The following step was equipping of disconnector with additional electro-mechanical equipment for disconnector remote control and status signaling.
  The reclosers for outdoor installation network with all circuit breakers functions, are relatively of more recent date and are equipped with the elements allowing remote control from dispatching center, normally equipped with adequate protection adjusted to act selectively to the protection in original SS

ELEKTROKRAJINA DISTRIBUTION NETWORK

The company for electrodistribution ZDP "Elektrokrajina", Banjaluka, operates the area comprising 19 municipalities . According to the status from 2003, there are aprox 4722 km of distribution network

(10,20 kV) 3242 SSs 20(10) /0.4 kV sa 807 MVA installed capacity . SSs are of various types :(brick made , concrete-premounted, concrete, PMSS , in the other facilities and similar) The equipment i SSs is the combination of all domestic and foreign manufactures of electric equipment. Within "Elektrokrajina" is the working unit " Elektrodistribucija Banjaluka" which in consumption makes approximately 50% from total company consumption.
To the Banjaluka network, which cover 2531 km^2 belongs 235 km of cable, 1220 km of overhead medium voltage network and 1139 SSs 20(10)/0.4 kV . The network is supplied from six supplying SSs.
In the urban area the network is mostly cable network and the major part of overhead network belongs to suburb of rural areas. The frequent faults on the lines are the cause of the interruption in regular supply of significant number of electricity consumers.
According to the data obtained by dispatching control center the majority of the faults are in the area of od Bronzani Majdan , Saracica, Han kola, Rekavice, Krupa na Vrbasu, Potkozarje , Misin Han Piskavica. Strong winds and snowfalls are the causes of frequent faults on overhead medium voltage networks and the finding of the fault point and the remedy of the same can take a long time, which causes longer interruptions in the electricity supply to the consumers in these areas.
The course in the selection of overhead networks was: stable and functional network, the fast location of the point and the detection of fault cause, the separation of the part of the network in operation from the part of nonoperational network and fast repairing intervention.
On the basis of statistical data for the number of failures and the time spent remedying them the selections of locations for installation of one power disconnector and one recloser in 20kV network of Banjaluka suburban area was performed. As a pilot project two 20kV TLs were selected namely:

-20 kV TL SS 110/20/10 Banjaluka - Bronzani Majdan and the supply from -20 kV cubicle No.49 in SS Banjaluka III.
-20kV TL 110/20/10 kv Banjaluka – Saracica(the supply from 20kV cubicle No. 50 in SS Banjaluka III).

In May, 2003 , installation of auto recloser on concrete pole in Gornji Maksimovici(The supply from 20kV cubicle No. 49 , SS Banjaluka III) and load disconnectors on concrete pole in Cerge(the supply from 20kV cubicle No.50 , SS banjaluka III) was performed. This is ilustrated in enclosed schemes 1 and 2.

THE DATA ON INSTALLED EQUIPMENT

Auto-recloser, type GVR 27/12, on the concrete pole in Gornji Maksimovici , has folloving characteristics:

-Rated voltage 27kV
-Rated current 630A
-Rated breaking capacity 12.5kA
-Rated withstanding test voltage U_1=125kV
-Rated frequency 50/60 Hz

Auto-recloser has built in vacuum chambers and comprehensive current measuring transformers 200/1A with accompanying drive , and the housing of auto-recloser is filled with SF_6 gas at 0.35 bar pressure. The voltage measuring transformer 22.000/100V, 100VA, 50Hz surge arresters and antenna are also mounted on the pole. The cabinet for remote control with installed accompanying equipment (overcurrent and earth fault protection , radio receiver transmitter, battery, rectifier and other electronics) is also installed underneath of auto-recloser.

Load disconnector , type Fla 15/60, on concrete pole in Cerge has following characteristics:

-Rated voltage 25kV
-Rated current 400 A
-Rated thermic current I_{th}=16kA
-Rated dynamic current I_{dyn}= 40kA
-Rated frequency 50Hz

The auto recloser poles are equipped with electric arc extinguishing chambers. The voltage measuring transformer 22.000/100V, 100VA, 50Hz surge arresters and antenna are also mounted on the pole.
The cabinet for remote control with installed accompanying equipment (drive mechanism overcurrent, radio receiver (transmitter), battery, rectifier and other electronics) is also installed underneath of disconnector.
The dispatching control center has the following installed equipment:
Complete computer equipment, antenna, radio receiver/transmitter and battery.

THE CONTROL OF INSTALLED EQUIPMENT

For signal transmission, during remote control, the existing system of radio communications is used. Control of installed equipment (switch on and off) can be achieved in three ways:

1.Remotely from dispatching control center
2.Locally at site from remote control cabinet
3.Manually with purposefully installed handles

The basic element of communication-control assembly of auto-recloser and load disconnector is Com-Energo programmable logical automat in modular form which has radio-modem output and communication line and is equipped with two equall microprocessors .The existence of two egual microprocessors allow for safer and more reliable operation of system in fault and nonstandard operation mode situations.

Service software is installed in the computer in dispatching center . Dispatching software hasn't been installed since this is pilot project. In case of installation of more devices dispatching software will have to be installed.

Installed software has following functions:

-Control of auto-recloser and load disconnector
-Signaling of the status of installed equipment (on-off)
-Signaling of battery status
-Signaling of protection funcuion and possibility to adjust it (only for recloser)
-Signaling of opened control cabinet
-Signaling of AC voltage failure
-Signaling of switch to local control from remote control cabinet

Beside signals on the screen , which is written and marked with appropriate colour, each status change is accompanied with sound signal and blinking at the place where equipment is installed ie. where status is changed.
All operational events: switching on and off energizing, protection reaction (for auto recloser) battery status etc. are logged in control computer memory in real time and they represents the basis of chronological list of operational events.
When control is local, at the site in the control cabinet , it isn't possible remotely from dispatching center to perform any manipulation.

THE EXPERIENCES GAINED WITH INSTALLED EQUIPMENT

The equipment was installed on the location where according to data provided by the service for the control of electric power system ,the frequent faults due to snowfalls and strong winds were observed , and as a consequence many settlements were blackouted from 2 to 20 hours, depending on the location and nature of faults. The fault, which is not temporary , on 20kV lines, whether ,main or branches activated the protection in 20kV cubicles No. 49 or 50 in SS110/20/10 kV Banjaluka III. All distributive SSs along the faulted line became nonenergized. The maintenance crews went along the line locating the fault location. While doing this the manual separation of line sections were performed and switching on of the 20 kV cubicle where protection was activated and the attempt of protection reactivation. Frequently, the protection was activated again since the cause of fault was not detected. This manner of fault location detection is time consuming because of branched network and

inaccessability of terrain , time needed for line inspection and time needed to reach disconnector and manual disconnection. Even more every disconnection on energized line requires the switching off of circuit breaker in feeding SS 110/x kV , because existing circuit breaker are not foreseen for manipulation while line energized.
The installed equipment has been in function for a year and the results are positive.
The advantages of auto recloser and load disconnector installation , controlled from dispatching center, are the following:

-Less frequent interruptions in electricity supply to the consumers
-Control and monitoring from one location which is time as well as operational costs saving.
-The elimination of the switching off of the whole line during fault location detection and fault remedy.
-Fast fault location detection and repair of the same.
-Fast separation of faulted line section from functioning sections
-The possibility of manipulation of power disconnectors while the line is energized
-Safer maintenance crews terrain works whether scheduled or fault repair
-Fast and reliable signaling of equipment status and any change
-When fault is downstream from auto recloser protection activation automatically switch of faulted section, while all distribution SSs upstream of auto-recloser are energized
-Logging of all operational events in control computer memory
-The installed equipment is (according to the declaration of supplier) maintenance-free.

As a support to the statement that the experiences with installed equipment are satisfactory, here is comparative review of the operation with previous equipment (disconnectors manually operated) and review installed equipment (load disconnector remotely controlled and recloser):

No.1: Manually operated disconnectors, on the pole on 20 kV line, location Cerge the faults were registered behind of disconnector, activating protection in SS 110/x kV Banja Luka III (cubicle No. 50), observation period 6 months before the installation of new equipment

Average time needed for the crew to reach the fault location and manual disconnection on the pole in Cerge	Average time needed to reconnect 20kV voltage to disconnector	Average interruption in electricity supply to the consumers supplied from SSs in front of disconnector
45 min	15sec	2715 sec

No.2: Load disconnector, remotely controlled, on the pole 20kV line in Cerge
The faults were registered behind of load disconnectors, activating protection in SS 110/x kV Banja Luka III (cubicle No. 50), observation period 6 months after the installation of new equipment

Average time needed for the crew to reach the fault location and manual disconnection on the pole in Cerge, from dispatching centar	Average time needed to reconnect 20kV voltage to disconnector	Average interruption in electricity supply to the consumers supplied from SSs in front of of disconnector
8 sec	15sec	15sec

No.3: Manually controlled disconnector, on the pole on 20 kV line, in Gornji Maksimovici.
The faults were observed behind of disconnector, activating protection in SS 110/x kV Banja LukaIII (cubicle No. 49), observation period 6 months before the installation of new equipment .

The number of faults behind of manually controlled disconnector	Total interruption time in the supply of electricity to the consumers supplied from SSs in front of of disconnector	Average time needed for fault location detection, manual disconnection of the voltage to disconnector
12	60 hours	5 hours

No.4: Recloser, on the pole on 20 kV line in Gornji Maksimovici.
The fault were observed behind of recloser, activating protection , observation period 6 months after i installation of the new equipment

The number of faults behind of recloser	Total interruption time in the supply of electricity to the consumers supplied from SSs in front of of disconnectors	Average time needed for fault location detection
7	0	1,5 hours

The transition to free market conditions by Power Utility of RS will cause greater demand for automation and remote control and monitoring in the development of distribution networks and the equipping of existing networks with similar equipment.

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