A SUGGESTION OF THE TYPICAL SOLUTION IN BUILDING IN OF THE GROUND SWITCH IN THE 110/20 kV SUBSTATIONS

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SUMMARY

The ground switches eliminate temporary ground fault connections in the 20 kV networks with the resistor in star connection efficiently and without temporary disappearances of voltage. The Power Distribution "Sombor" has been using them for more than six years. At the moment, they are functioning on two substations 110/20 kV and the third is in final stages of building. We have approached this matter in a creative manner, created a remote function control and made huge archives. We consider ourselves experienced enough to suggest a typical project.

Not considering the producer of automatics and switches and the quality warranty we think that the ground switch should be connected to busbars through the outflow cell with the protection and not with busbars disconnector. This is because the ground switch is a local automatics with a very intensive season work, up to 2500 manipulations a year, up to 50 a day. This is similar to the automatic regulation of voltage.

For the automatic regulation of voltage we have extremely high-quality equipment. Yet, malfunctions happen, rarely and with less damage then at ground switches where the transformer 110/20 kV is turned off and, depending on the distribution organization user gets without voltage from 10 minutes to 1 hour until the teams get in position and turn off the disconnector.

Typical procedure for classical substations with 20 kV plant on the higher floor and that are the most common in "Elektrovojvodina" is with outflow switch in a cell MTK2, the ground switch in the cable space behind it and automatics in relay drawer of the home transformer, with the remote surveillance and possible remote blocking of automatics during the malfunction search. This is what we already

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have built in. As some new ideas we suggest building in the additional currency transformers in neutral 20 kV spots, function blocking on the ground fault connection with purely cable outflow and slowing down of the automatics for 40 milliseconds.

For all other types of substations the option stays the same, only the location of built-in equipment changes from case to case. Building in over the outflow switch makes possible to built typical compact solution of ground switch in the same drawer with automatics. This would be ideal for the 20 kV plants with movable switches because of the hardly solved building in of ground switches cart. Solving this problem awaits us at the end of the year for the substation 110/20 kV Sombor 1.

Key words: Typical solution, Ground switch, Outflow switch

INTRODUCTION

In five 110/20 kV substations which are used in the Power Distribution “Sombor’s” area, ground switches are built in three. With percentage of 60, we are definite leaders in Elektrovojvodina. The benefits of this investment we see through the satisfied customers, because they do not have temporary voltage losses, and lesser number of outflow switches manipulations, which causes less need for maintenance. We have decided to take care of the two remaining stations as soon as possible.

This job we have been doing completely ourselves, from the very beginning (building in, testing, function starting, function following and maintenance), which forced us to act creatively, so we make some innovations every time, according to the experience we’ve gained. This is why we’ve decided to suggest a possible typical solution.

LINKING THE GROUND SWITCH OVER THE OUTFLOW SWITCH

Linking the ground switch over the outflow switch to the collectors on the busbars, instead of just with busbars diconnector makes the potential malfunctions outflow instead of busbars. The solution is significantly more expensive. Nevertheless, we use it not considering the built-in equipment quality of the ground switch, because the experience tells us that nothing is a hundred percent reliable. The ground switch with an automatic regulation of voltage has the most intensive function on the substations. Even though the equipment for automatic voltage regulation is very professional and high-quality, malfunctions that happen have much less consequences then those of the ground switch. We evaluate that the price of building in a outflow switch with the protections is covered with one transformer turning off with stopping the customer supply of one half of hour.

This solution widens the possibilities for choosing the placing spot of the ground switch poles. In classical substations the outflow switch is built in the MTK2 cell with microprocessor protection at the front side of the cell, in a relay compartment. Accessory relays and fuses (until the central computers are built in the stations) we place in the relay drawer MTK2. Poles of the ground switch are being built in the cable compartment behind the MTK2 cell, an the automatics in the relay drawer of the home transformer. The link between the outflow switch and the ground switch poles is developed with the copper busbars. Cable compartment is locked with the “bure”-lock, which key is sealed with the key of the busbars disconnector, which grants the highest level of safety for the personnel, during the interventions.

In modern substations with 20 kV switches on cart, one outflow with the cable connection feeds the ground switch. The ground switch itself and the automatics are placed on the free location, depending on the space available. We are considering the compact solution with the drawer in which we would place the switch poles and automatics, wit the appropriate protection of the unappropriate manipulation. It would be appropriate for the classical substations, which makes possible the equipment typization. Now, the ground switch building in on a cart is hard and uncertain job.

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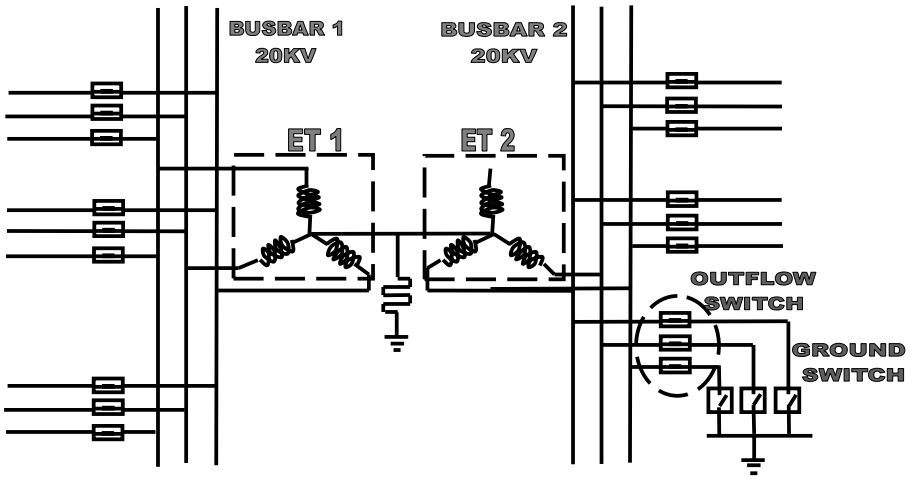
The outflow switch is in the system of the remote control and surveillance. This enables dispatcher to turn it off during the malfunction search, and us to use this for blocking the ground switch function. At the moment, we are testing different solutions on two substations. On one, remote turning off outflow switch blocks the ground switch automatics, on the other automatics stays active and the ground switch works without the connection with busbars in the TEST-state. We are more likely to accept this second solution as typical because we gain the information about the phase struck by the malfunction, even though we do not eliminate the malfunction itself.

On the picture 1. the scheme of building in of the ground switch according to our typical solution is shown.



Picture 1: The scheme of ground switch building-in

ADJUSTING THE OUTFLOW SWITCH PROTECTION

In the cell of the outflow switch for feeding the ground switch tree current measuring transformers 300/5 A are being built in. On the microprocessor relay the short-circuit and ground fault connection are being adjusted. Short-circuit protection is being adjusted at 1200 A. With the momentary contact it blocks short-circuit busbars protection, and the switch turns it off after 0.2 seconds. The ground fault protection is adjusted at 60 A with the time member adjustment at 0.4 seconds. Our experience is that with the adjustment of the on-state time of the ground switch of 150 millisecons remains enough time for the switch inertia at he turning off.

Chronologically Sorted Data is built in the microprocessor relay and gives us information about the currencies through the poles at the short circuits with ground as a result of overlap at the spot with damaged isolation. At the single-phase ground faults, the other two phases rise up to the interphase voltage towards the ground, which sometimes initiates the overlap, short-circuit and the turning off of the badly isolated outflow. As the ground switch rigidly grounds in the busbar on the known resistance of the substation ground-in, the idea is to, by recording the malfunction current, do the macrolocation of the weak spots on the network and eliminating them and, by this, improving the statistics of the ground switch efficiency and prevent the greater malfunctions.

REMOTE SIGNALLIZATION

The remote signallization of the ground switch involves the impulse phase signals, turn-on and turn-off of each phase signals and the irregular-function signal. By this, the velocity of the answer of the switch on the “on” and “off” order can be followed. These signals have been introduced because of the problems with the switch mechanics and they are about to lose their significance because the

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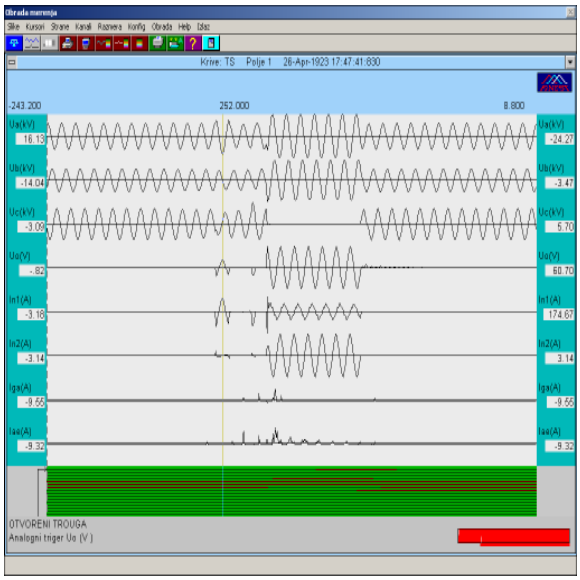
switches are being updated and new, more qualitied solutions. Yet, the signal that defines the phase struck by the malfunction remains significant.

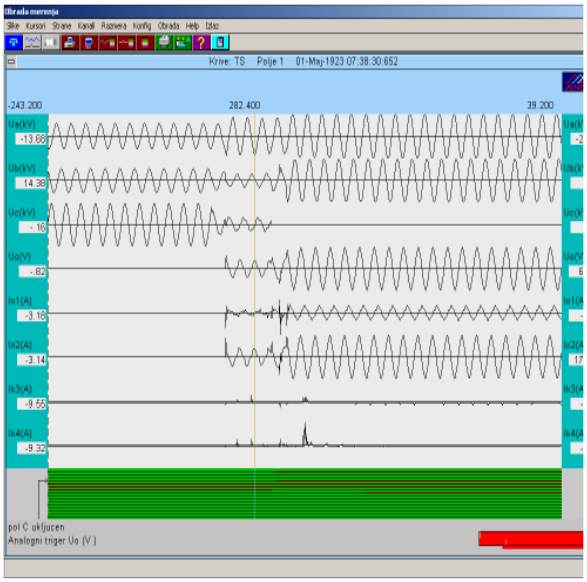
At the remote signallization of the outflow switches, we have changed our philosophy about the ground protection- instead of operative command signal we are introducing the impulse that awaits the term from the ground switch to become operative. This gives us the information from which outflow the malfunction comes. This is of significance for dispatchers to send the team for the non-scheduled revision of the overhead lines if the impulses from the same outflow become frequent, even though the users don't feel that. At the same time engineers who follow the network gain the information that they have lost after the ground switch building-in. The former system of network quality tracing by analyzing the counter displays of Automatic Reclosure Relay loses it's significance when the ground switch is built in. Over ninety percent of these malfunctions are eliminated by the ground switch and leave no trace on the counter displays. Signallizations that we are developing momentary gives the information about the outflow that sends the malfunction and on which phase. What is yet to be developed is a program for daily and monthly summing, by which we regain the lost data.

THE AUTOMATICS SLOW-DOWN

The wish from ground switch to answer on the malfunction as soon as possible brought up some unexpected problems. Although the automatics had been developed and checked to be blocked on the interphase malfunction, which the ground switch objectively cannot solve, sometimes the turning on occurs. If one subvoltage element runs slightly late with the impulse, or the malfunction develops in a way that the voltage of both phases does not decrease at the same time, and there is current in the neutral, the switch turns on the pole which subvoltage element reacted more rapidly. We found the solution in slowing down the automatics for 40 to 50 milliseconds and giving it the time to "decide". We don't expect the negative consequences on the ground switch work efficiency because now we have unequal pole turning on velocities without significant difference in following sensations. On the pictures 2. and 3. we see the records of the malfunctions recorded with a help of the Chronologically Sorted Data at which the automatics slow-down would prevent the futile work of the ground switch.



Picture 2: Short-term disturbance



Picture 3: Double ground fault connection

On these picture the voltages of all three phases (Ua, Ub, Uc), the voltage of the opened triangle (Uo), current in the neutral spots of both transformers (In1, In2) and the current of the ground fault connection of two outflows are shown.

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Slowing down makes it possible for us to block the turning on of the ground switch on a malfunction that comes from purely cable outflow because the malfunction like that is very rarely of the passing character. The impulse signal that we have used for the remote signallization we can use for blocking the function of automatics. By this we achieve the same that we had without the ground switch- the cable outflows are instantly and permanently turned off, without the automatic recloasure.

BUILDING IN THE ADDITIONAL CURRENT TRANSFORMERS

While checking and testing the function of the ground switches it is required to cut the voltages of certain phases and give the current of appropriate values to the automatics. Cutting the voltage is not a problem, but for the current simulations the bypassing of the neutral 20 kV current flow and to remove the wires towards the current element of automatics if this is being done without turning off the transformer 110/20 kV. Since the neutral current is 20 kV, the reserve ground protection for the outflows, and the main for busbars, we think that it is better to build in the additional current transformers on the row with these existing, which would be used only for the ground switch. By this, we would be sure that we won't have contact mistakes, which could bring serious negative consequences, leave the transformer without the ground protection.

CONCLUSION

Building in of the ground switches slowly gains new supporters. Being the persistent promoters of this idea, from the first meeting with it in the year 2000, we suggest this typical solution- the result of our researches and experiences. Building in the outflow switch makes it possible to have greater reliability in delivering the electric power and creative approach of the dispatcher while looking for the malfunction, the remote signallization gives us a number of useful information, automatics slow-down and ground control blocking from the cable outflow, less unsucsessful attempts, building in additional currency transformers increases the certainty and measuring of the malfunction current is an attempt to discover the week spots on the network.

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