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THE REMOTE FUNCTION CONTROL OF GROUND SWITCH

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SUMMARY

The ground switch is multiply useful device- it seriously decreases the number of short disappearances of voltage, it enables safe functioning of industries which have command AC voltage and it disburdens the feeder switches. On the territory of Power Distribution “Sombor” has been present from 31.07.2001. in substation 110/20 kV Sombor 2. In March 2004. it is supposed to be functional in substation 110/20 kV Odžaci too.

The specificity in exploitation of ground switch in substation Sombor 2 is twofold:

-This is the first, and as we know, the only ground switch that was built in the substation with two separate transformers 110/20 kV with strength of 31,5 MVA and which are not in parallel connection;

-The ground switch is controlled by the remote.

This paper is about experiences with remote control of ground switch. We are trying to suggest this as a typical solution.

Because of the evaluation that the number of information would overload the function of a remote station the following signals are suggested:

-Disconnector of the ground switch on – off,

-Disturbance in function of the ground switch,

Ground switch is treated as local automatics. Our idea is to make it an active element of Electro-Energetic System. We’ve came up with supplemental signals:

-Poles R, S, T on – off

-Impulse faze R, S and T

-Impulse of ground protection of feeder

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Comparing lists with Chronologically Sorted Data and the data received from the device for automatic monitoring that had been used for parallel control of ground switch function, we have concluded that the device is needles and can instead be set free for other monitoring. Information received from the remote station enabled us to monitor the function of the switch and condition of the distribution network. It turned out that a very important term is “another” or more precise “frail isolated” feeder.

In this paper the comparison will be given between CSD from the substation Odžaci which has no ground switch and Sombor 2 with ground switch for the same sensation- temporary or permanent ground fault connection. Our aim is compare the damage caused by increased number of signals and the benefit from received information.

The analysis of distribution network condition by reading the dial-plate on the devices for Automatic Reclosure Relay feeders by building in ground switch are now getting a new dimension. Ground switch is taking on the role of fast ARR for all feeders. Because of this the remote signal of ground fault connection impulse is interesting. We know from which feeder the damage comes.

Introduction

Building in of ground switches in the substations 110/20 kV in “Elektrovojvodina” is still not common. This is the reason why experiences are poor and works about this topic are rare. Switches and control system devices are made according to requests of “Elektrovojvodina” and are practically represent prototypes. Ground switch is being connected to busbars 20 kV in substations 110/20 kV and its irregular function usually results in turning off the transformer, which can leave the entire area without power supply, until the expert teams come to the spot. Because of all this, the seriousness of approach to this problematic is understandable.

The specificity of PD “Sombor” is the first building in of ground switch in the substation with two separate transformers that are not in parallel connection, connected by the resistor in star connections. One switch is built in because of shared resistor. It was clear that this must work, but we were expecting the first successful turning on because of damage from transformer on which the switch was not built in.

Because of this we had chosen to examine the ground switch in two ways, during the experimental work:

1. By monitoring the sensation as suggested in the project

2. By bringing on more signals in remote station

The idea was that by comparing the received results we find optimal number of signals which will enable successful monitoring of function and setting free the device for automatic monitoring for other monitoring. The dilemma about burdening the remote station by large number of signals was solved by choosing the presently available and permanently memorized data. The aim of this work is to give an overview and analyze of justifiableness in usage of this approach from three-year distance.

Briefly about ground switch

The ground switch is being built on busbars 20 kV in substations 110/20 kV to eliminate temporary ground fault connection on the network without switching off the consumers. It consists of three single-pole vacuum switches with electro-magnets that turn them on and springs for turning off. Automatics can recognize the phase that was struck by ground fault connection; it then gives approval to turn on the switch of this phase. Switch remains on in time that can be set on the device of automatics, the impulse of switch spool is stooped and then spring turns it off. Ground protection of feeders is blocked during these cycles and gets approval to start working only if eliminating the ground fault connection is unsuccessful, which means that damage is permanent.

About remote stations

By introducing the remote control, signalization and measuring in substations 110/20 kV a great step forward was done. Distribution network manager has an overview of the network condition, the capability of manipulation without presence of workers and signalization of all changes of state. The greatest progress is connected with analysis of irregular situations because the received signals are sorted by the time of occurrence and at the moment of occurrence of the sensation. Past analysis connected with counter and relays with flag were hard to do and mostly incomplete.

Services that cope with analysis of sensations are interested in the greater number of signals. Creative monitoring of condition of network and built in in equipment brings us to the need to renew the listing of signals- either by canceling some that are estimated not productive or by connecting new ones. That is how we have delt with the ground switch. We were not in dilemma if we needed more signals but what number is optimal.

We have decided to divide needed signals into two groups:

1. The function control switch and automatics,
2. The control of state of network 20 kV.

The function control of ground switch.

The switch and automatics are practically prototypes. Their makers are different companies. In order to, in case of incorrect function, have a clear image of who is “guilty”, we have decided to introduce the following signals:

1. Impulse of ground fault connection in each phase,
2. On-off state of all three poles of the switch,
3. Potential 128 (temporary signal).

Signal of fault ground connection impulse was attached from the relay connected parallel to the spool by electro-magnet of the switch, and the on-off state with limit switches. Signal “potential 128” occurs when the feeder ground fault connection protection get the approval to work after functioning of ground switch and we consider it temporary because it is used only in checking. On this way we successfully control the following:

1. Impulse of the specific phase compared with signal “Uo> signalization of ground fault connection” which was received from the open triangle of voltage measuring transformers in the measuring cell 20 kV,
2. The response of the switch pole to the impulse-time of engage,
3. Lasting period of the account of impulse engagement which is possible to set on the device of automatics,
4. The response of the switch after the end of impulse-time of shut down,
5. Occurrence of conditions needed for the function of ground fault protection feeders,
6. The response of feeder switch.

We have all of these informations on the CSD of the remote station, listed by the time of occurrence and with accuracy of 10 ms.

The conditions of function of the ground switch are extremely hard. The number of manipulations is big. On the substation 110/20 kV Sombor 2 from the 1st of May 2003 until the 1st of May 2004 it has been working 295, 1125 and 523 on the phases R, S and T. The most intensive work is in summertime because of the birds on the fields during the harvest season, while it is nearly inactive during the winter. It happens that one phase of the switch, mostly S which is the highest on the pillars and is attractive to the birds,

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works 10 times one after another and 30 times daily. This is one more reason to follow the speed of turning the switch on and off so that we can act preventively if we spot changes in timing.

The control of network state

The analysis of network state had been done with a help of number of fast and slow ARR read from the counter display of the specific devices. By building in the ground switches this gets a new dimension. Temporary ground fault connections, which are the most common sensations in 90% of these cases, is being eliminated by appropriate equipment without a trace on mentioned counters. It appears that the quality of the network is drastically approved. So, in order not to amnesty the overhead lines maintenance teams we have decided to activate a signal of impulse of ground fault protection for feeders. On this way we recall the information of number of ground fault connections on the feeders with a new quality- we always know what phase it is about.

Along with archiving of these information dispatcher is able to, if he spots greater number of impulses of the same feeder, send a team to the non-scheduled check of the overhead lines with remark on which phase they should pay attention to.

With a help of this signalization we have introduced the term “poorly isolated feeder”. While the ground switch is working, it happens that the ground fault connection become two-phase short circuit with the ground because of increase of the voltage on the other two phases and overleap on the weak spot. However, from time to time, the current of the damage, because of the distance and smoother ness does not reach the values of the short circuit current. That bring to the impulse of ground fault connection from one feeder and it’s successful eliminating and also shutting down the “poorly isolated feeder”, which is the consequence of overlap on one of other two phases.

It is possible to determine the phase on which the “weakened isolation” is located because during the ground fault connection on it the poorly isolated feeder is not being turned off. By repairing these “weak spots” we can approve the quality of the network. Introducing the term “poorly isolated feeder” changes the statistics of ground switch productivity.

Signalization in the substations with and without ground switch

Temporary ground fault connections with successful quick ARR in the substation 110/20 kV Odžaci without ground switch is marked by following signal (19.4.2004.)

11:13:37.590	ODZ_M21	Uo> signalization of ground fault connection	occurrence
11:13:37.590	ODZ_M22	Uo> signalization of ground fault connection	occurrence
11:13:37.600	ODZ_I206 Deronje	Io> ground fault protection	occurrence
11:13:37.680	ODZ_I206 Deronje	SWITCH	set off
11:13:37.720	ODZ_I206 Deronje	Io> ground fault protection	stop
11:13:37.740	ODZ_M22	Uo> signalization of ground fault connection	stop
11:13:37.750	ODZ_M21	Uo> signalization of ground fault connection	stop
11:13:37.980	ODZ_I206 Deronje	SWITCH	set on

In the substation 110/20 kV Sombor 2 which has a ground switch the same sensation is marked by following signals (29. 4. 2004.)

07:33:52.310	SO2_ I209 B.Monostor	Io> ground fault protection	occurrence
07:33:52.320	SO2_ ground switch	Impulse of phase “S”	occurrence
07:33:52.320	SO2_ M21	Uo>signalization of ground fault connection	occurrence
07:33:52.360	SO2_ M22	Uo>signalization of ground fault connection	occurrence
07:33:52.380	SO2_ ground switch	Pole “S”	set on
07:33:52.450	SO2_I209 B.Monostor	Io> ground fault protection	stop
07:33:52.500	SO2_ ground switch	Potential 128 (temporary)	occurrence
07:33:52.500	SO2_ ground switch	Impulse of phase “S”	stop
07:33:52.600	SO2_ ground switch	Pole “S”	set off
07:33:52.630	SO2_M22	Uo>signalization of ground fault connection	stop
07:33:52.640	SO2_M21	Uo>signalization of ground fault connection	stop
07:33:56.430	SO2_ ground switch	Potential 128 (temporary)	stop

It is notable that instead of 8 we have 12 entrances. However, the impulse of phase of ground switch occurs when current in neutral of one of the transformers 110/20 kV increases and, at the same time, voltage of one phase decreases under the set-on value. This signal is valid enough and we can eliminate the signals from the opened triangle. Also, we eliminate the signal “potential 128” which was introduced as temporary and after ending the test period it has lost it’s value. That way we come to smaller number of entrances (6 compared to 8) in the substations with the ground switch.

Signal of ground fault connection from the opened triangle can be doubtable. When introducing the remote monitoring it was planed to signal impulse of ground fault connection locally and time-stretching ground fault connection is signaled by the remote. Long before building in the ground switch we had turned these two signals reverse because of the following reasons:

1. Local signal of ground fault connection blinks all the time and no one pays any attention to it any more,

2. Remote signal has a small chance to appear (long lasting of ground fault connection) except when the resistor of the neutral is damaged,

The changes that we have introduced resulted in following:

1. Local signal (time-stretched) is getting on its importance and can be linked to the sum-signal which warns the dispatcher by radio

2. Remote signal shows that ground fault connection is real

This second thing is important because in our distribution ground fault protection of feeders and transformers 20 kV is homopolar. It happens that because of the contact loss on the links in secondary current circuits protection mistakenly reacts. If we have the signal impulse from the opened triangle this problem can be noted quickly.

In case that this signal is eliminated on all substations we have 4 entrances in substation that do not have ground switch compared with 6 those who posses this system. However, the quality of signals “impulse of phases R, S or T” appears to be big enough to justify increase in number of entrances, especially because there is a possibility of selecting signals on CSD by objects or parts of objects. The unsuccessful attempt of removing the ground fault connection is followed by similar relation of entrances.

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Conclusion

Remote signalization of ground switch function and, connected with it, momentary impulse of feeder ground protection had justified the expectations. We are not afraid of enormous overcharge of the remote stations because the number of added signals is not great. If we accept the arguments for introducing the ground fault connection signals from the opened triangle number of entrances is getting smaller. The possibility to "clean" CSD by selecting, for instance, substation 110/20 kV Sombor 2, ground switch and all feeders on it, gives us additional arguments. "Cleaned" lists are given in the examples in last chapter. Analysis of sensations and network state are getting the new dimension because we know which feeder and which phase is damaged. We can establish on which phase the isolation of "poorly isolated feeders" is damaged.

After introducing the term "poorly isolated feeder", we are beginning to doubt in present ground switch successfulness statistics. We think that shut down of feeder which had not initiated the ground fault connection can not be added to the list of unsuccessful workthroughs.

Dispatchers had quickly got the feeling for series of signals at normal function of ground switch and they warn the maintenance teams about every change in it.

After taking in consideration everything mentioned so far, we feel free to suggest introducing of remote control of ground switch as a typical solution for new projects and building in.

USED LITERATURE

1. EPS, Elektrovojvodina, Project bureau, Novi Sad, June 2000, "Project-technical documentation for building in ground switch at substation 110/20 kV Sombor 2",

2. M. Radunović, N. Pešalj, "Some experiences with ground switch in substation 110/20KV Sombor 2", CIRED 2002,

3. EPS, Elektrovojvodina, Project bureau, Novi Sad, July 2002, "Project-technical documentation for building in ground switch at substation 110/20 kV Odžaci".

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