

Tavrida Electric Reclosers for Automation of the Distribution Networks of Russia

Dr Alexey CHALY
IG TAVRIDA ELECTRIC
cam@ig-tel.ru

Vladislav VOROTNITSKIY
IG TAVRIDA ELECTRIC
vvv@tavrida.ru

Sergey BUZIN
IG TAVRIDA ELECTRIC
bsa@tavrida.ru

Sergey BENZORUK
IG TAVRIDA ELECTRIC
bsv@ig-tel.ru



ABSTRACT

Recloser philosophy has not been traditionally applied in the former USSR. Structure of networks and relevant problems are not exactly the same as for traditional recloser markets. This paper describes some special cases and relevant solutions provided with the aid of Tavrida Electric reclosers in response to these problems.

INTRODUCTION

Russian power industry is subject for substantial change in recent years. With the stable economic growth achieved in last decade requirements for reliable power supply are constantly growing. At the same time about 40% of equipment used in distribution network is totally run down, about 80% require capital repair. Average sustained interruption duration index (SAIDI) reached 70 hours per year, average number of sustained faults experienced by customer - 25/100km per year [1].

Under these circumstances traditional protection philosophy applied in the former USSR failed to provide required level of supply reliability in many special cases. In these cases

authors found the ways to improve reliability of supply with the aid of vacuum recloser manufactured by Tavrida Electric. This recloser has a set of the following distinctive features making it a particularly suitable for the said cases from the installation, maintenance and functionality standpoints [2]:

- No maintenance needed during the entire lifetime (the recloser doesn't contain SF6 and part to be repaired)
- Long mechanical and interrupting life (up to 30 000 CO operations at rated current)
- Absence of environmentally hazardous media (SF6 or oil)
- Low temperature (applied materials and technologies allow reclosers to be used in regions with down temperature range -60C)
- Small dimensions and weight (OSM weights ~65kg)
- Application of silicon rubber as a main circuit insulation providing suitability for operation in heavy polluted environments [3]
- Ability to measure phase to earth voltages from both sides. The recloser has built in measuring system consists of voltage capacitive dividers and Rogowski coil. It allows to realize directional protection and use module in ring lines, as for consumers with high demands of the reliability of power supply without additional current and voltage metering system.
- Protection flexibility supporting necessary functionality for radial and ring line applications
- Support with TELUS software providing SCADA-master functionality.

The paper describes particular application problems and relevant solutions offered and implemented with the aid of said reclosers.

AUTOMATED BACKFEED RESTORATION SYSTEM FOR IMPORTANT CUSTOMERS

Automation of power supply system for the cultural and museum complex "Battle at Borodino" located in the outskirts of Moscow presents typical example how application of reclosers can increase reliability of the power supply.

The museum had three independent sources: main source

and two backup sources. However the backup sources equipped with old manual sectionalizers could not provide automatic restoration of power supply in case of permanent fault. As a result it generally took from 4 to 8 hours to locate the fault and restore power supply.

Figure 1 illustrated distribution system which has been used for the project. It was decided to install three reclosers. Two of them (R1 and R2) were used as automatic backfeed restoration points and the third (R3) as a sectionalizing recloser. In order to increase reliability of the supply, reclosers R2 and R3 were installed in the near vicinity of 10/0.4 kV transformers feeding the museum. An outage of the museum is possible only in case of the occurrence of the permanent fault between R2 and R3. Fault in any other section of the line cannot lead to the outage. Ability of the Tavrada Electric reclosers to measure phase to earth voltages from both sides allowed to restore power supply independent from which side power supply source is presented.

Calculation carried out within the project shows that the reliability of the museum power supply increased by 82%.

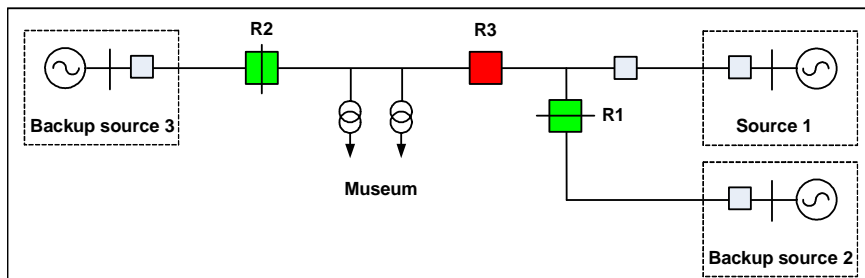


Figure 1 – Recloser for purpose of backfeed restoration of power supply

SELECTIVE INCREASE OF POWER SUPPLY RELIABILITY

Traditionally customers in Russia are split into categories with regard to penalties paid by power supply company in case of power outage. Customers ranked for the first category are considered to be the most sensitive to the power outage and are supposed to receive higher reliability of supply.

Generally for feeding such customers extra overhead line used for backup supply had been considered. Needless to say, that this solution was extremely expensive.

We have offered an alternative solution which schematic is shown in Figure 2.

Each customer has been connected to the line using two 10/0.4 kV transformers (see Figure 2). Transformers have been connected to the line from both sides of normally closed reclosers R1, R2, R4, R5, R6 and R8. Automatic tie scheme has also been provided on the 0.4kV side of these transformers for the first category customers. For the automatic backfeed restoration on the 10kV side additional tie reclosers R3 and R7 have been installed. As it seen from Figure 2 this scheme allows providing power supply for the

first category customers in case of location of permanent fault at any section of the line. And again ability of Tavrada Electric reclosers to measure voltages from both sides together with flexible protection functionality appeared to be decisive factor for the success of the project.

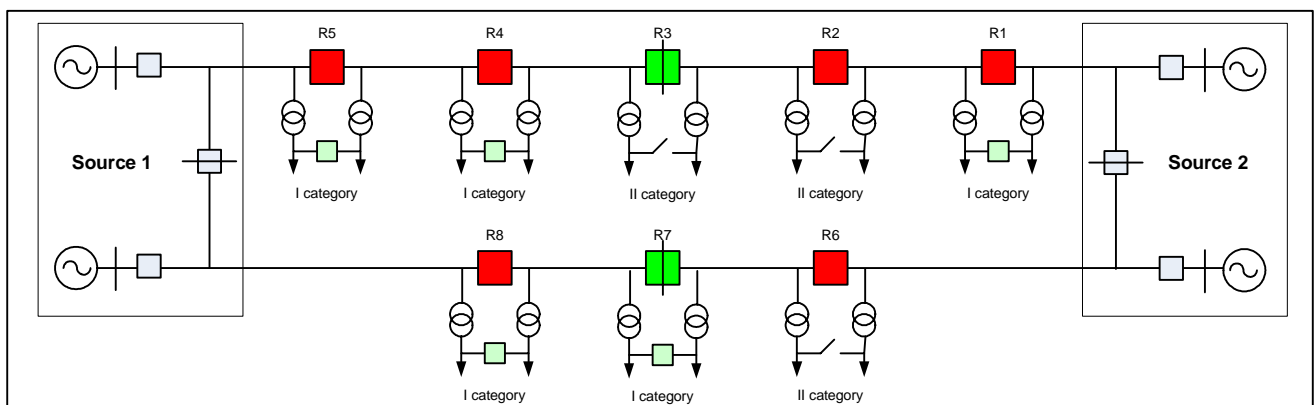


Figure 2 – Functionality allow to co-ordinate a great deal of reclosers

AUTOMATION OF POWER SUPPLY FOR PIPELINE EQUIPMENT



Figure 3 – Application of the Tavrida Electric reclosers in the gas-and-oil producing industry

First of all it has been considered to apply as a main power supply source for pipeline equipment turbo generator independent of existing power supply system. However application of just one power source has not been considered sufficient for maintaining requested level of reliability. That is why additionally backup supply from two existing sources has been provided as shown in Figure 4.

Line length in this particular case exceeded 100 km. None of the sources except of turbo generator was able to provide supply for all loads located in the line. That is why it was decided that turbo generator would supply the line during its normal operation. In case of outage main supply would be interrupted with the aid of recloser R5, the line would be divided into two parts with the aid of sectionalizing reclosers R4, R3 and R2 (depending on the location of the fault) and powered from two existing sources via automatic back feed reclosers R6 and R1 (Figure 4).

Flexibility of measuring and protection functionality of Tavrida Electric reclosers allowed successfully implementing this project. Another important features contributing to its success appeared to be:

- “no maintenance” feature particularly important in this application where equipment has been located far from the service points
- ability to operate at low temperatures relevant for this application

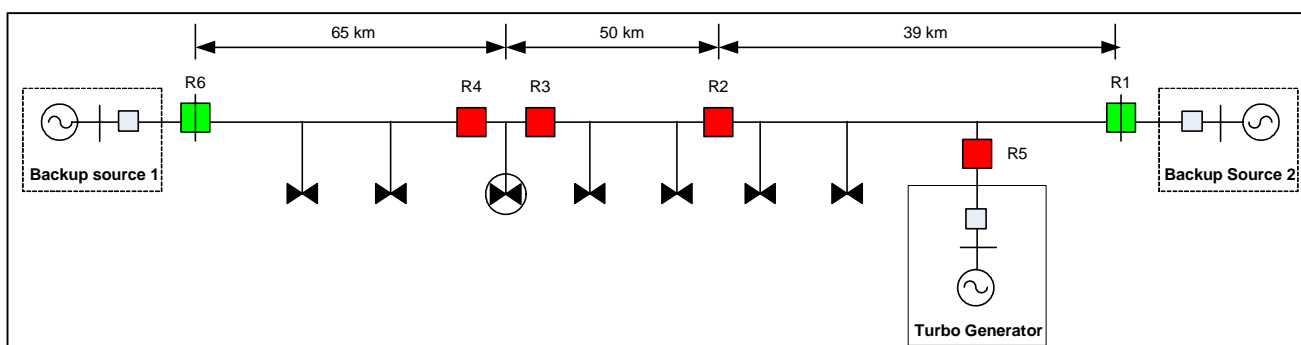


Figure 4 – Power supply automation of crude pipeline system of Caspian Pipeline Consortium

Power supply automation of crude oil pipeline system of Caspian Pipeline Consortium (CPC) was another interesting project. In old system pipeline equipment had been supplied from several sources. These sources had not been owned by CPC and all of them had very low level of reliability. Therefore improvement of the supply reliability for CPC equipment (and distributed SCADA objects in particular) appeared to be high priority task for CPC.

SUBSTATION APPLICATION

Tavrida Electric Reclosers support functionality generally required for substation applications. Ability to operate at temperatures as low as -60C, low dimensions and lightweight allow creating competitive solution on the basis of these reclosers (compared with the conventional solution based on application of indoor substations with circuit breakers).

The very first project based on the application of reclosers

for substation has been implemented in West Siberia (Tomsk Network Company). The substation has included two incoming and four outgoing feeders and one recloser has served as a back feed. Bus bars have been separated into two parts (two outgoing feeders for each part) by a sectionalizing recloser closed automatically if voltage loss on one side occurred.

Remote control of the substation has been provided with the aid of TELUS software, included in the delivery set. Only two radio modems have been used for remote control of the substation. All reclosers have been connected to a radio modem through interface RS 485 using communication controller.

This solution satisfied all functional requirements related to protection and communication requested by customer. In addition decrease of capital and service cost (due to lack of heating generally used for indoor substations) has been achieved compared with conventional indoor substation.



Figure 5 – Substation application of the reclosers in Siberia

CONCLUSION

Though recloser philosophy has not been historically applied in power industry in Russia, distinctive features of Tavrida Electric reclosers allowed providing solutions competitive to the traditional ones in many niche markets.

AKNOWLEDGEMENTS

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