



*All power grid companies fight against shutdown on lines. Flashover of glass suspension insulators mostly occur because of spread of contaminated parts and its wetting. It is not enough to find a "problem area" but it is needed to make a right decision about the exchange...*

GIG operation division studies the problem cases in operation and selects optimal solutions for consumers. Test center Global Insulator Group has been accredited by the Federal Agency for Technical Regulation and Metrology and meets requirements of the international standard ISO/IEC 17025:2005.

Representatives from the Russian Interregional Distributive Grid Company (IDGC) of Urals- "Chelyabenergo" branch has addressed to GIG division with a problem of periodic shutdown of segment on line. **Object:** HV 110 kV Rakitnaya-Aleksandrovskaya, insulators of PS70E (U70BS) type.

**Operation conditions:** Steppe area.

**Problem:** For several years round during the end of July - September frequent shutdown occurred especially in the morning (2013-2015).

**Request:** To research the reason of string flashover and to work out measures for its prevention.

### **Test research.**

Flashover of string glass insulator units manufactured by OAO "YuAIZ" in 1983-1986 was observed during the inspection of overhead lines. Trace contaminations of grey-brown color, trace of flashover, lots of spider web along the string and between phases were observed.

The shutdown analysis has showed that in most cases it happened at the time of temperature differences (formation of dew point).

While the shutdown segment is located in the agricultural area, chemicals conducive to insulation pollution were not used. Reportedly, the reason of shutdown of 110 kV Rakitnaya-Alexandrovskaya overhead line is the insulation flashover occurring along the wetting spider web when the dew falls.

Insulators removed from the transmission line were tested in several steps:

- glass chemical test of insulators removed from the line;
- flashover power frequency voltage (dry, wet, moisture, environmental conditions) test;
- comparison of the received data with the new analogue.

Tests of the removed insulators of PS70(U70BS) type showed that discharged voltage (dry) of single insulators is 3% lower than new insulators, wet– 18% lower.

The discharge voltage (dry) of the removed string insulator unit is 3% lower than the new string unit, wet – 10% lower, moisturizing – 30% lower. The main reason of decrease of discharge characteristics of polluted insulators in dry and dew fall condition is humidification of the polluted layer. Water penetration is common for this type of pollution and leads to the loss of insulation characteristics.

According to the location of the overhead line the source of pollution is milled ground and dust lifted by the wind blow and deposited vertically by some angle on insulation of the overhead line. Lower ribby part is more polluted because of poor washing by the rain and self-cleaning. It is important for a string insulator unit, where a middle part is polluted, to shield from flowing contaminations from the cross-arm, rust and the absence of polluted glass parts where the part of string insulator unit is mostly loaded (near the wire).

As the insulating parts are polluted not only from the above but also from the below, it is recommended to protect it from both sides. Thus it is suggested to install insulators of aerodynamic profile from the above and below the string unit. Thanks to the insulating part of a larger diameter, aerodynamic insulators protect the string unit from pollution by external factors. To confirm it the comparison between discharge and withstand power frequency voltage (dry, wet, moisture (to simulate the dew) tests were conducted. Tests were conducted on the string unit of 5 insulators of PS70(U70BS) type removed from the line, string unit of 2 aerodynamic insulators of U120AD from the above and below and 3 insulators of PS70E (U70BS) type removed from the distribution lines, and string insulator unit of new insulators of PS70 type.



Fig.1 Test of new configuration string unit

Results of the comparison tests are shown below:

Name	Withstand voltage, kV (60 sec)			Discharge voltage, kV		
	Dry	Wet	Moisture (dew)	Dry	Wet	Moisture (dew)
String unit of 5 insulators of PS70E (U70BS) type (new)	252	184	242	265	206	256
String unit of 5 insulators of PS70 type removed from IDGC line	245	175	165	257	185	173
String unit (new) 2 insulators of U120AD type and 3 insulators of PS70E (U70BS) type	285	195	250	297	212	268
String unit of 2 insulators of U120AD type and 3 insulators of PS type (IDGC)	285	182	246	297	205	262

According to the test results discharge and withstand voltage (dry, wet, moisture) of the mixed type string insulator unit is higher than string unit of one type insulators.

**ПРОТОКОЛ**  
испытаний стекла, снятого с линии ОАО «МРСК-Урал»

от « 23 » ноября 2015 г.

**Химический состав:**

Определяемые окислы	Массовая доля, %	
	норматив	факт
SiO <sub>2</sub>	72,4 ± 0,3	72,23
Al <sub>2</sub> O <sub>3</sub>	2,4 ± 0,2	2,13
Fe <sub>2</sub> O <sub>3</sub>	не более 0,15	0,10
CaO	7,5 ± 0,2	7,71
MgO	3,5 ± 0,2	3,64
K <sub>2</sub> O	3,9 ± 0,2	3,80
Na <sub>2</sub> O	9,9 ± 0,3	9,88
SO <sub>3</sub>	не более 0,3	0,30

И. о. начальника Лс \_\_\_\_\_

  
(подпись, фамилия)

Е.В. Бредихина

Главный технолог ООО.ЦСИ \_\_\_\_\_

  
(подпись, фамилия)

С.Г. Внукова

**Fig.2 Test record of the removed glass insulators shows the glass chemistry of constituents is within normal limits**

It emerged that deposits are washed only with acid and non-water-soluble.

According to the expert mind, the reason of non-washable deposits can be complex cause which have been united:

- chemistry pollution from the ground nearby the overhead line;
- previous ground spray by agricultural aviation;
- land chemical cultivation which settle on the surface of insulators by the wind blow;
- contaminations blown by the wind from other areas (power, industrial, salt properties);
- electrical intensity of overhead line.

Perhaps, there still exist sources of pollution which can be the basis for chemical reaction. There is no single cause for contamination accumulation but only complex.

**GIG-operation division recommends for reduction the number of emergency shutdown in overhead lines:**

1. Application of mixed type string insulator units including aerodynamic profile.
2. Cleaning from time to time insulators from contaminations in the overhead lines.



**Fig. 3 Tests (wet) of insulator previously used.**



**Fig. 4 New configuration string insulator unit test (wet).**