

The report of Energoservice Ltd. on the Session of CIGRE 2014, August 25

We have since long ago been focusing on the development and introduction of innovative products specifically for Russia's major companies such as Russian Railways, Avtodor, Norilsk Nickel, Russian Grids (Rosseti), Federal Grid Company (FGC), etc. Our work is based on the principle of **“Providing simple solutions to big problems”**, and our engineering efforts focus, in the first place, on improving safety and reliability of power transmission lines, hoisting, transport and electrical power infrastructure.

Our products boast new designs, with many of them being purpose-built for large companies with account of specific features of application environment. For the purpose of design engineering, tests and certification of new products, Enrgoservice Ltd uses the services of the lead science organisations, specialists of operator companies and industry-related research institutes.

Our industrial partner – Severstal-Metiz JSC – is always open for innovations. Upgrade of the facilities of this company focuses on expanding product range and improving quality of the products designed exactly for the Russian Railways JSC, Russian Grids JSC, MMC Norilsk Nickel and other large companies. Thanks to the newly commissioned equipment, including Europe's newest zincing plant and cable tensioner, we can provide enterprises with absolutely new Russian products, e.g. fully tensioned cables to withstand loads of any level. This will radically improve the quality, life time and reliability, and will enable to produce, with the world-level quality, the types of products that had never been produced in the CIS.

Creative team of Enrgoservice Ltd., jointly with representatives of the Moscow Power Engineering Institute, FGC Engineering Centre and a number of other science centres and operator companies, developed and launched to mass production ground wire for overhead power transmission lines which has successfully been in service for several years. The project included a large package of research, development and introduction works for creation of a principally new lightning protection of overhead power transmission lines.

These efforts resulted in an essentially new and unique product steadily providing for the desired mechanical, electrical and thermal characteristics and maintaining the initial properties and serviceability even after exposure to a 147 coulomb lightning stroke, and resistance to impact of any types of real loads. Product advantages also include its significantly higher strength which allows for the use of smaller diameters without loss of reliability, shorter sags and many other features.

This solution along with all of our other developments reflects our efforts to achieve the quality required by operators without use of highly expensive materials or production process. This will ensure the best technical/economic effect for the users and the use of the entire range of product advantages.

This further resulted in the development of the OPGW (also referred to as OKGT) optical ground wire maintaining all properties and advantages of our ground wire. The product boasts extremely high mechanical and thermal strength, including in the case of a lightning stroke or short-circuiting. Optical module tube is made from special stainless steel strip.

When creating OPGW we were guided by several fundamental promises:

- The product, as well as ground wire must protect power lines from lightning, within the maximum values registered it.
- The product shall retain the original characteristics throughout the life cycle, regardless of any external influences.

- Availability aluminum coating improves the resistance only to short-circuit currents, **but** worsening resistance discharge lightning, strength, sag, and a number of other characteristics.

Tests have shown that our OPGW has sufficient resistance to short-circuit currents (**I² to 330kA**). Settlement possible more current can be expected on some lines only at the approaches to the substations. Therefore, it is not advisable to use more expensive steel-aluminum product, also less durable, on all extent overhead lines.

The OPGW has passed a full range of certification tests under the FGC UES standard and European standard.

While designing plastic-deformation products, we came up with an essentially new technical solution for high-strength and high-temperature wires. We managed to dispense with sophisticated and costly processes used by many manufacturers. With this, we achieved similar, and sometimes even better, characteristics as compared with those shown by shaped wires, through a simpler and less expensive technique. Besides, plastic deformation of not only the aluminium part, but also the steel core, enables to preserve lubricant inside, thus significantly improving corrosion resistance of the core and life time of the wire.

As a result, we supply high-strength and high-temperature steel-reinforced aluminium bare wires, with plastically compressed steel and aluminium parts. Wires of three basic designs are manufactured at Severstal-Metiz facilities, and those are intended for use in 35–750 kV overhead power transmission lines.

The wire shows good resistance when exposed to any natural impacts, and provides for a higher mechanical strength and a larger aluminium cross section while retaining the same diameter.

In the absence of constraints associated with the routing of the line, the use of our conductors can lead to a 25% capital cost savings in the project due to the smaller number of supports.

The unique design of the wire and the wire steel reinforcement system, developed by our partner Elektrosetstroiproekt, enabled us to make an upgraded version of the wire with operating temperature of 150 °C and the maximum temperature of 210 °C without use of the alloys that decrease conductive properties.

The HTSA (also referred to as ASVT) high-temperature steel-reinforced aluminium wire has a double capacity as compared with a standard steel-reinforced aluminium wire and 1.5 capacity as compared with AERO-Z of similar diameter. This means that our new HSSA (also referred to as ASVP) high-strength steel-reinforced aluminium wires and HTSA wires expand the scope used for the design of overhead lines and enable to resolve the tasks that either could not be resolved before or involved high costs.

The task assigned by the Russian Railways was even more complex.

We were required to create a purely copper-made product with a variety of features: high mechanical strength, low variation of length when exposed to temperature fluctuations, corrosion resistance, electric conductivity of copper, better aerodynamics performance, standard diameters, sufficiently good manufacturability for mass production, no significant price rise for the end product, and compatibility with standard reinforcement.

Pure copper is known to have almost the best (second to silver) conductivity, while bronze features high strength. Life time of overhead wiring could be extended through increasing the cross section of copper cable or wire and through replacing copper wire with bronze wire with the same cross section, although this will raise the price of overhead wiring.

In the first case electrical power losses will decrease, while in the second case they will grow.

Alloying could increase strength and wear resistance, while electric conductivity of copper should be preserved. However, addition of any alloys will result in higher price of the product.

Based on the above-said assumptions, a copper suspension cable was developed to provide for a better conductivity and mechanical strength with the same diameter. In other words, this is a copper cable with the properties of a bronze cable!

With this, we did not use any alloys, and succeeded in resolving the task solely thanks to the design.

We therefore resolved the task by creating a suspension cable featuring a number of advantages: high mechanical strength, insignificant variation of length during temperature fluctuations, corrosion resistance, sufficient electric conductivity, better aerodynamics performance, standard diameters, sufficiently good manufacturability for mass production, with no significant price rise for the end product. The design provides for a copper suspension cable with higher strength without introduction of alloys leading to the increased losses.

Today, the cable has passed certification tests in the All-Russia Research Institute of Railway Transport in line with the Russian Railways requirements, and pilot tests at the most congested segment of the South-Ural railway.

Strength loss is found to be within allowable limits even after double overheating to 155 °C during all tests. The cable does not stretch when heated. With this, in view of a larger cross section of our cable the amperage causing overheating will be much higher as compared with standard product. Additional investigations of tensile strength during heating to 200 °C gave successful results.

Our team is constantly involved in the development of, and experiments with, new materials. One of such developments enabled us to shortly fulfil a major order – suspension cables for the Ostankino TV tower. It was not only in-house-developed raw materials and skills of production staff, but also international cooperation of several enterprises arranged by our company that enabled to actually save the unique structure of the tower from destruction.

All of the Company designs have either obtained or will soon obtain patents of the Russian Federation and the European Union. Our products were highly assessed at applicable exhibitions UpGrid-2012 and Hannover Messe-2013.

Energoservice LLC and Severstal-Metiz JSC continue to actively work both for upgrading their developments and for creating new innovative products, while viewing their strategic partners as the leaders in application of new technologies. We are confident that we are able to fully meet the most stringent requirements.