Evaluation of the Profitability of High Temperature Low Sag Conductors

Svetlana Berjozkina[1], Antans Sauhats[2], Edvins Vanzovichs[3], [1-3]*Riga Technical University*

Abstract **– The application of High-Temperature Low Sag conductors is one of the possible methods for improving the existing transmission network nowadays, especially if the transmission network requires prospective expansion of new electrical connections.**

The purpose of the study has been to evaluate conductors of conventional core designs like AS, ACSR and composite core designs like ACCC and ACCR on the basis of the technical and the economic criteria, and to establish which of these conductors would be preferable for upgrading the existing network.

The comparative evaluation was based on an existing overhead line model of the Latvian power network. The results of the analysis are presented in this paper.

Keywords **– Efficiency, estimation technique, power transmission, supply quality, transmission of electrical energy.**

I. Nomenclature

ACCC	Aluminium Conductor Composite Core
ACCR	Aluminium Conductor Composite Reinforced
ACSR	Aluminium Conductor Steel Reinforced.
AS	Aluminium Steel Conductor
HTLS	High Temperature Low Sag Conductor

II. Introduction

Since the transmission grid expansion will be required due to the significant impact of renewable energy sources, which are expected to dominate Europe's energy supply [1], as well as the impact of important power players such as Russian Federation, which is expected to increase its generation capacities by the construction of a nuclear Power Plant (NPP) in Kaliningrad, the Belarus and Visaginas NPP in Lithuania.

It is necessary to utilize new transmission line projects in the operation of the grid. For example, the construction of the planned "Kurzeme Ring" – an energy infrastructure project in Latvia, with the main purpose of establishing the interconnection Latvia – Estonia – Sweden for improving the power supply reliability in the Baltic countries [2]. However, the low level of capital investments in the building of new transmission lines reduces the chances of achieving the desirable result.

Therefore, it is possible to use the existing infrastructure of the transmission grid with maximum extension of new technologies into the existing power line systems with less economic investment and high technical security.

Upgrading of the existing transmission lines is an important subject, which has been widely discussed in the recent decades. Different solutions have been used for implementing this concept with maximum use of line, for example, reconstruction of the overhead line for a higher voltage, replacing the existing conductors by ones with a larger cross-section, installation of series and shunt compensations, construction of new supply substations, using control devices for the power network, increasing the permissible load current [3].

The case study is to consider the profitability of replacing the conventional core designs conductor with a HTLS conductor [4], [5], [6] by technical and economic evaluation.

The comparison of the proposed application has been based on an existing Latvian power line model. The analysis of an evaluation results are presented in the paper.

III. The Initial Data of the Overhead Line Model

A. The existing Overhead Line Route

For evaluation purposes, an existing overhead line route LN-266A of the Latvian transmission network has been selected (see Fig. 1). The length of the existing transmission line is 6,7 km.

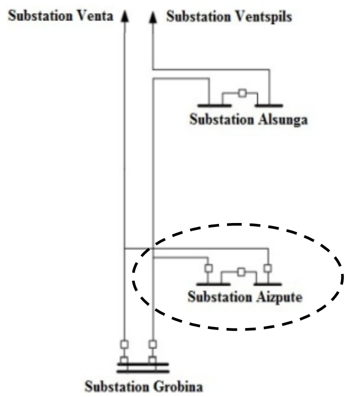


Fig. 1. Electrical diagram of the existing overhead line route LN-266A.

The simulation tasks were based on the pre-design version as one part of the planned "Kurzeme Ring" project – Aizpute branch. It means that the line tower and conductor types were chosen according to the technical specification requirements of a pre-design version, but with some assumptions:

1) As a length of the selected overhead line of 6,7 km that is too small for observing the necessary profitability of the simulation tasks, a 50 km long 110 kV single-circuit overhead line was conditionally assumed;

2) In the technical specification of a planned project a new LN-266 has to transmit current not less than 1200A of a 110 kV circuit, but in this paper a maximum electric power capacity of 850 A has been selected;

3) The existing initial data of an overhead line LN-266A of a conductor type is AS-95/16, but for the new transmission line LN-266 it will be ACSR 242-AL1/39-ST1A, therefore the conductor types were selected according to a new conductor ACSR.

The climatic conditions in the transmission line route area are assumed as follows:

- Wind pressure: 65 kg/m2 (wind region II);
- Ice thickness: 10 mm (icing region II);
- Minimum temperature: –35°C;
- Maximum temperature of conductor: +35°C;
- Maximum temperature of conductor: +70°C;
- Average operating temperature: +5°C [7].

As 110 kV overhead line towers, S110-2 (1T-24) type concrete intermediate and AT110-2 (3T-23) tension towers were adopted (see Fig. 2).

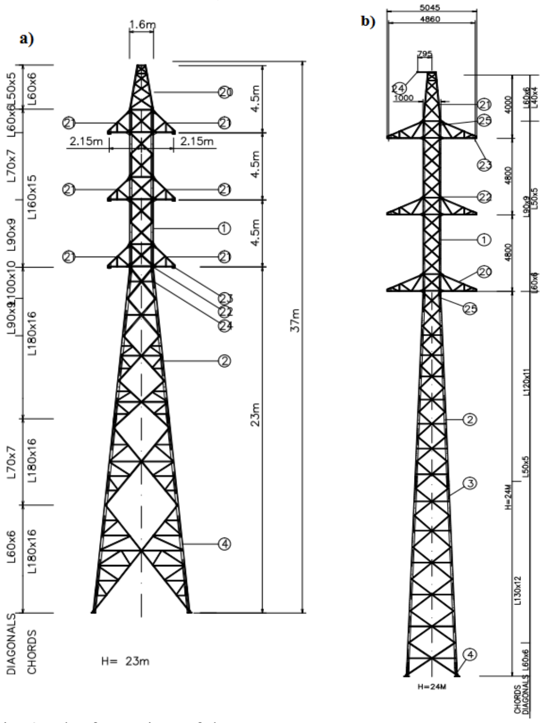


Fig. 2. The front view of the towers:
a) AT110-2 (3T-23); b) S110-2 (1T-24).

B. The Technical Characterization of the Selected Conductors

There are five different conductor types, which are taken as the basis for the simulation tasks. The technical data of the conductors are presented in Table I.

The presented conductors were selected taking into account the main technical parameters – the cross-section area of the aluminium in a conductor and an active resistance. Therefore, as the selected conductor of a new power line LN-266 is ACSR 242-AL1/39-ST1A, then an aluminium steel conductor AS-240/32 and three HTLS conductors with similar corresponding parameters were selected.

TABLE I

TECHNICAL DATA OF EXAMINED CONDUCTORS FOR LN-266

Symbol	Quantity	Unit	AS-240/32	242-AL1/39-ST1A	Glasgow	Casablanca	Hawk 477
d	Conductor diameter	mm	21.6	21.8	19.53	20.5	21.6
s	Conductor cross-section	mm^2	275.7	282.5	284.42	309.74	277
E	Conductor modulus of elasticity	kg/mm^2	7700	7849	7640	7450	7800
α	Coefficient of linear expansion	1 /°C	$19.8/10^6$	$18.99/10^6$	$17.49/10^6$	$18.63/10^6$	$16.7/10^6$
P1	Conductor linear load	kg/m	0.921	0.98	0.743	0.823	0.793
Y1	Conductor reduced specific load	$kg/m \cdot mm^2$	$3.34/10^3$	$3.469/10^3$	$2.61/10^3$	$2.66/10^3$	$2.86/10^3$
P4	Linear load of maximum wind	kg/m	1.227	1.238	1.21	1.164	1.227
P3	Linear load of conductor weight and ice weight	kg/m	1.814	1.879	1.578	1.685	1.686
N	Conductor quantity per phase	pcs.	2	2	1	1	1

The presented conductors are an aluminium steel conductor AS-240/32, ACSR and three HTLS conductors with similar corresponding parameters [8].

The conductors “Glasgow” and “Casablanca” are of the ACCC type, the conductor “Hawk” is of the ACCR type, and the last of the selected conductors, “242-AL1/39-ST1A”, is an ACSR.

The traditional type of conductor ACSR is a concentrically stranded conductor composed of one or more layers of hard-drawn aluminum wire stranded with a high-strength coated steel core [9].

The ACCC conductor consists of a hybrid carbon and glass fiber core, which is stranded with trapezoidal shaped aluminium strands [10].

The ACCR conductor relies only on aluminium-based materials. The core is a revolutionary aluminium alloy that has the strength and stiffness of steel with a lower coefficient of thermal expansion and less weight [11].

IV. A COMPARATIVE ASSESSMENT OF THE EXAMINED CONDUCTORS

The special program “SAPR LEP 2011” was used for systematic calculation of the examined conductors. The calculation methodology includes approximate interrelationships based on the parabolic sag curve. It is assumed that both ends of the conductor span are situated at the same level. Then a calculation of the critical spans follows and, based on it, a determination of the modes for conductor estimation. These are followed by the systematic conductor calculation itself, based on an equation of state for eleven modes [12].

The technical comparison of the examined conductors was based on mechanical and thermal limitations, as well as the economic profitability.

A. The Technical Evaluation of the Conductors

Concerning the mechanical limitation, in this case the mechanical tension, conductor sag, the permissible span was adopted.

The obtained results of the systematic calculation of conductors were taken only for two modes:

1. conductor heat-up mode at +35°C;
2. conductor heat-up mode at +70°C;

Both modes were taken as the restricting modes for the placement of towers on a profile (the limitation for the maximum sag in a particular span).

The mechanical tension of a conductor for both modes is presented in Fig. 3, 4.

Fig. 3 shows that the tension in a line for the heat-up mode at +35°C of the ACCC and ACCR conductors is higher as compared with the traditional type conductor, in this case AS and ACSR. The same tendency is observed in a power line for the conductor heat-up mode at +70°C in Fig. 4, but in this case the mechanical voltage values of the examined conductors are smaller as compared with the conductor heat-up mode at +35°C.

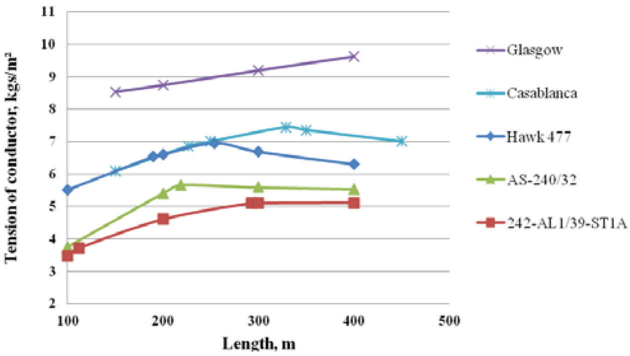


Fig. 3. The tension-length relationship in a conductor heat-up mode at +35°C of the different types of conductor of a line LN-266.

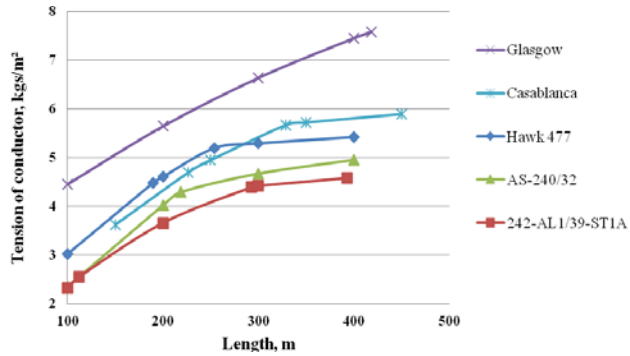


Fig. 4. The tension-length relationship in a conductor heat-up mode at +70°C of the different types of conductor of a line LN-266

The conductor sag for both modes is presented in Fig. 5, 6. After analyzing the received values, it can be concluded, that for both graphs the largest sag occurs in conductors of conventional core designs like AS and ACSR compared with the HTLS conductors like ACCR and ACCC.

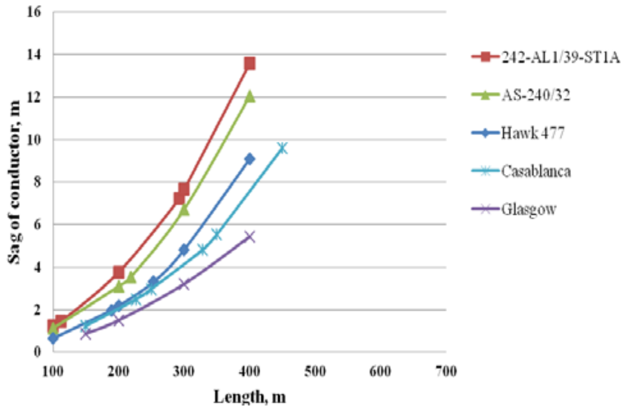


Fig. 5. The sag-length relationship in a conductor heat-up mode at +35°C of the different types of conductor of a line LN-266.

The permissible spans of the examined conductors are presented in Fig. 7. It shows that the wind spans (L_{wind}) are the decisive spans of all described conductors. For example, L_{wind} of an AS-240/32 type conductor is 403.6 m, which is the worst parameter as compared with the clearance span (L_{cl}), which is 436.5 m at +35°C and 414.0 m at +70°C, and the weight span (L_{weight}), which is 414.3 m.

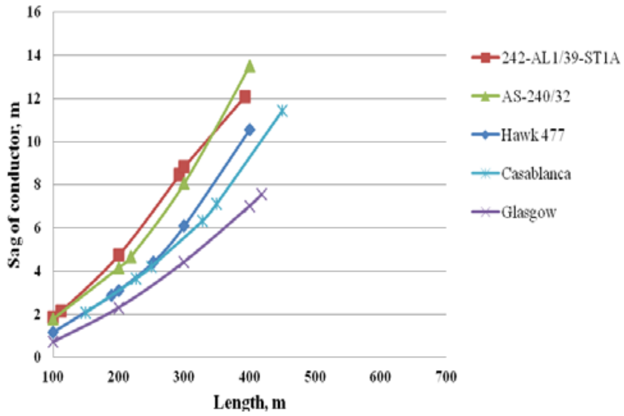
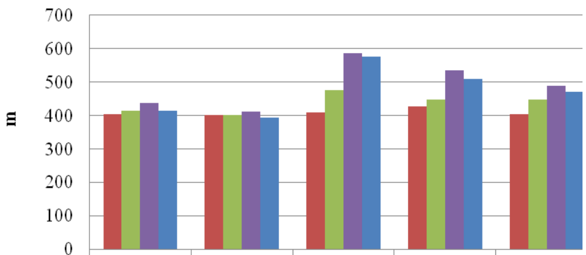


Fig. 6. The sag-length relationship in a conductor heat-up mode at +70°C of the different types of conductor of a line LN-266.

For other conductors, this comparison has the same behavior. The conductor “Casablanca” is preferable, because the maximum allowable wind span is 425.4 m, which is by about 25.4 m more than in the case of using “242AL1/39-ST1A”, or by about 21.8 m more than in the case of using “AS-240/32” and “Hawk 477”, and about 16.1 m more than in the case of using Glasgow, if all the other conditions remain the same.



	2xAS-240/32	1x 242AL1/ 39-ST1A	1x Glasgow	1x Casa-blanca	1x Hawk 477
Lwind	403.6	400.0	409.3	425.4	403.4
Lweight	414.3	400.0	476.3	446.1	445.8
Lcl at +35°C	436.5	411.8	585.9	533.3	487.4
Lcl at +70°C	414.0	393.0	574.9	508.2	470.1

Fig. 7. The allowable wind (L_{wind}), weight (L_{weight}) and clearance (L_{cl}) spans of the different types of conductor of a line LN-266.

Concerning the thermal limitation like the capacity of the line and the permissible conductor temperature for the comparison purposes, it is presented in Table II.

As a result it can be concluded that the HTLS conductors like ACCC and ACCR have the maximum permissible conductor temperature compared with the ACSR and AS conductor. In this case the installed capacity of 850 A is provided with one conductor per phase for ACCC and ACCR as compared with the AS and ACSR (see table II). Therefore, the higher is the permissible conductor temperature, the higher is the capacity that can be transmitted over a particular overhead line, of course without worsening the electrical parameters. For example, if the conductor "Casablanca" is used, then its permissible conductor temperature is 120°C and as a result it provides 922A of one conductor phase.

Unfortunately, this aspect has also a negative effect, in this case, the active power losses, which have a tendency for rising with the increase of the maximum current (see Table II).

TABLE II
THE THERMAL PARAMETERS OF DIFFERENT CONDUCTOR TYPES FOR LN-266

Installation of a conductor									
AS-240/32		242AL1/ 39-ST1A		Glasgow		Casablanca		Hawk 477	
Thermal limitations									
Permissible conductor temperature, ºC									
70		80		120		120		210	
Permissible capacity, A									
2 conductors per phase	1210	2 conductors per phase	1260	1 conductors per phase	852	1 conductors per phase	922	1 conductors per phase	1293
AC and DC resistance at operating temperature, Ω/km									
R_{DC} at 20°C	0.1182	R_{DC} at 20°C	0.1195	R_{AC} at 120°C	0.16842	R_{AC} at 120°C	0.14808	R_{AC} at 210°C	0.2045
Active power loses (ΔP_a) at operating temperature, kW/km									
246.9		284.6		366.8		377.7		902.7	

B. *The Economic Evaluation of the Conductors*

The economic comparison is based on two main criteria:

1) The quantity of tension and intermediate towers;
2) The total amount of required material and equipment.

The total investments for a transmission line model did not take into account power line losses, the lighting cable and its installation, the land and transportation costs, or operational and designing costs, because of, firstly, the case of a study was to evaluate how a saving of the quantity of intermediate towers as well as total required material and equipment including the chosen type of a conductor influences the total construction costs of a particular line, secondly, the initial investments of a pre-design version were reviewed only, but not the operation costs during the line exploitation. Besides, the presented comparative evaluation is of an approximate nature, since the prices are the subject to change.

The length of the route is assumed to be 50 km. Therefore, as the placement of towers on a profile depends on the calculated clearance, wind and the weight spans of the examined conductors, the quantity of intermediate towers (Ns) was determined for conductor heat-up mode at +35°C. It can be calculated with the following expression:

$$N = \frac{L}{L_{cl}}, \tag{1}$$

where L – the length of the power line route, m;

L_{cl} – the clearance span, m; the values of this parameter are presented in Fig. 6.

As a result, there are 125 pc for the conductor AS-240/32; 124 pc for 242AL1/ 39-ST1A; 122 pc for Glasgow; 118 pc for Casablanca and 124 pc for Hawk 477.

Therefore, when the number of towers is known, the total required material and equipment for line construction can be found.

An approximate calculation of the total investments (CΣ) consists of five main parts and is determined by the following formula:

$$C_{\Sigma} = C_c + C_s + C_f + C_{str} + C_{\Sigma i}, \tag{2}$$

where C_c – the cost of a conductor, r.v.*.;
C_s – the cost of a tower, r.v.;
C_f – the cost of a foundation, r.v.;
C_{str} – the cost of a string, r.v.;
$C_{\Sigma i}$ – the total installation costs, r.v..

Each component of (2) is determined by a corresponding expression, which is presented below.

The cost of a conductor (C_c):

$$C_c = n_c \cdot 3N_{ph} \cdot L \cdot c_c, \tag{3}$$

where n_c – the number of circuit in line (single circuit (n=1); double circuit (n=2) or more);

* Avoid index disclosure commercial information, the prices are given in relative value (r.v.)

N_{ph} – the number of conductor per phase;
L – the length of the power line route, m;
c_c – the price of conductor for 1 m, r. v.

The cost of a tower (C_s):

$$C_s = m_s \cdot N_s \cdot c_s, \tag{4}$$

where m_s – the metal weight for one particular tower, t;
N_s – the total quantity of towers, pc;
c_s – the price of metal of tower for 1 t, r. v.

The cost of a foundation (C_f):

$$C_f = v_f \cdot N_s \cdot c_f, \tag{5}$$

where v_f – the volume of reinforced concrete foundation for one particular tower, m³;
c_f – the price of reinforced concrete foundation for 1 m³, r. v.

The cost of a string (C_{str}):

$$C_{str} = n_c \cdot n_{str} \cdot N_s \cdot c_{str}, \tag{6}$$

where n_{str} – the number of strings for one circuit, pc;
c_s – the price of string for 1 pc, r. v.

The total installation costs ($C_{\Sigma i}$):

$$C_{\sum i} = C_{ic} + C_{is} + C_{if} + C_{istr}, \tag{7}$$

where C_{ic} – the installation costs of a conductor, r.v.;
C_{is} – the installation costs of a tower, r.v.;
C_{if} – the installation costs of a foundation, r.v.;
C_{istr} – the installation costs of a string, r.v.

The total investment for the construction of a 110 kV overhead line LN-266 (see Fig. 8), in the case of using the traditional type conductors “AS-240/32”, “242AL1/39-ST1A” and ACCR – “Hawk 477”, turned out to be higher than the costs of constructing a 110 kV overhead line, when using the HTLS conductors “Casablanca” and “Glasgow”. The difference between “AS-240/32” and ACCC conductors (“Glasgow” and “Casablanca”) is about 2.8%, as compared with ACCR (“Hawk 477”), where it is 3.9%. However, the total costs of a line using “Casablanca” is the optimal variant, because of minimum total investments – 84180000 r.v., then goes “Glasgow” – 85960000 r.v., then there are AS and ACSR conductors, and the last one is “Hawk 477” conductor of ACCR type with the total costs 87480000 r.v.

As a result, for these initial data of the particular line model, economic efficiency of using conductors with composite core is observed in the case with the ACCC conductor – “Casablanca”.

The high price of the ACCC and ACCR conductor types also play the main role; in the simulation task, it was taken to be about 2.5 times higher as compared with the traditional type conductor. If the price will be reduced, the application of HTLS conductors could be more productivity.

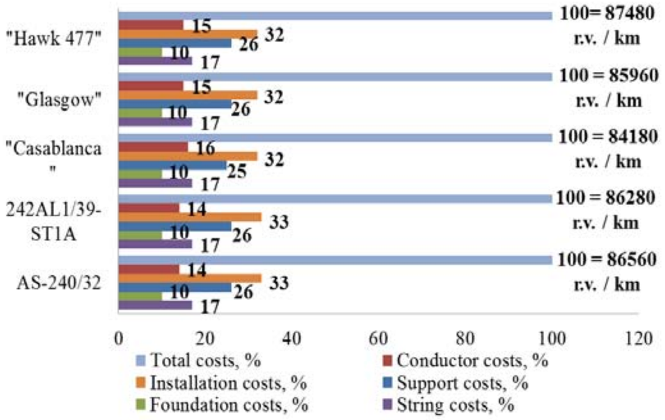


Fig. 8. Overhead line LN-266 construction costs.

V. Conclusions

The comparative assessment of conductors with conventional core designs like AS and ACSR and composite core designs like ACCC and ACCR was based on the technical and economic efficiency.

There are some main results of the technical comparison, demonstrating the following:

1) If the initial conditions remain the same, except the allowable conductor temperature of a particular type of conductor, ACCC (“Casablanca”) compared to traditional type conductor like ACSR (“242AL1/39-ST1A”) is preferable, because the wind span is increased by 25.4 m or by about 6.4%; correspondingly, the number of towers diminishes by 6 and the number of insulator units – by about 18;

2) The largest tension, therefore, the smallest sag and the largest clearance to the ground is observed in the case of ACCC and ACCR type conductors; an opposite tendency is observed in ACSR type conductors.

There are some main results of the economic comparison, which shows the following:

1) It can be concluded that the “Casablanca” type conductor has the smallest total construction costs (84180000 r.v.), whereas the conductor “Hawk 477”, which is ACCR conductor, has the highest costs (87480000 r.v.);

2) Concerning the traditional type conductors, which are AS-240/32 and 242AL1/39-ST1A, the total costs of it are higher as compared with the ACCC conductors;

3) If the price of conductors with composite core is reduced, the use of HTLS conductors replacing the traditional type conductors can be more economically justified, yet at the same time, it can be one of the reasonable methods for increasing the limited capacity of the existing overhead lines.

Acknowledgment

ESF
EIROPAS SOCIĀLAIS FONDS
EIROPAS SAVIENĪBA

This work has been supported by the European Social Fund within the project «Support for the implementation of doctoral studies at Riga Technical University».

REFERENCES

[1] O. Ozdemir, K. C. Veum, J. de Joode, G. Migliavacca, Andrea Grassi, Alessandro Zani. The impact of Large-scale Renewable Integration on Europe's Energy corridors. Proc. of IEEE PowerTech Confrence, Trondheim, 2011. pp. 1-8.

[2] The Kurzeme Ring. [Online]. Available: http://www.latvenergo.lv/portal/page/portal/english/LET/LET/about_network/KURZEME_RING/

[3] S. Beryozkina, A. Sauhats, E. Vanzovichs. Climate Conditions Impact on the Permissible Load Current of the Transmission Line. Proc. of IEEE PowerTech Confrence, Trondheim, 2011. pp. 1-6.

[4] D. A. Douglass. Practical application of High-Temperature Low-Sag (HTLS) Transmission Conductors. New Haven, Connecticut: 2004. p. 53.

[5] K. Kopsidas, S. M. Rowland, M. N. R. Baharom, and I. Cotton. Power transfer capacity improvements of existing overhead line systems. Proc. of Electrical Insulation (ISEI), Conference Record of the 2010 IEEE International Symposium on San Diego, 2010. pp. 1-5.

[6] S. Berjozkina, A. Sauhats, E. Vanzovichs. Modeling of the Load Current of the Transmission Line. Proc. of 10th International Conference on Environment and Electrical Engineering Conference, Roma, 2011. pp. 911-914.

[7] Electrical Code (EIN-7). Moscow: Gosenergonadzor, 2007, pp. 842 [in Russian language].

[8] Welcome to HTLS conductor. OHM TEKMIN. [Online]. Available: http://www.ohmtekmin.com/nuevo/documento/HTLSC_STACIR_Rev1.pdf

[9] Bare aluminum electrical conductors. Home page of "Sural" products. [Online]. Available: http://www.sural.com/products/bare/acsr.htm

[10] Ravi Gorur, Barzin Mobasher, Robert Olsen. Characterization of Composite Cores for High Temperature – Low Sag (HTLS) conductors. Final project report. PSERC Publication 09-05. June 2009. p. 52.

[11] Powering the next generation. Composite Technology Corporation. January 2007. V8.4 Public NYC. [Online]. Available: http://ctc-energy.com/products/files/block_1/page12_2.pdf

[12] The special program "SAPR LEP 2011" description. Modern design System. [Online]. Available: http://www.bsapr.ru/prod/progs/element.php?ID=250 [in Russian language].

Svetlana Berjozkina received B.Sc., M.Sc. in Power Engineering from Riga Technical University, Riga, Latvia in 2008 and 2010 respectively. Now she continues studying as PhD student in RTU. Her major field of study is power energetic.

She is presently an engineer at joint stock company „SiltumElektroProjekts" of Latvia. Her research interests include power supply, transmission lines state estimation, analysis of power systems as well as their mathematical modeling.

She is author of more than 20 papers.

E-mail: svetlana.berjozkina@gmail.com

Antans Sauhats received Dipl. Eng., Cand.Techn.Sc., and Dr.hab.sc.eng. degrees from Riga Technical University (former Riga Polytechnic Institute) in 1970, 1976, and 1991 respectively.

Since 1991 he is Professor at Electric Power Systems. Since 1996 he is the Director of the Power Engineering Institute of Riga Technical University; and the Director of an joint stock company „SiltumElektroProjekts". Area of research activity: power system automation and optimisation, protective relaying, development of methods and means for control of normal and emergency conditions in electric power systems, HV Transmission lines fault location.

He has more than 200 scientific publications.

Principal investigator of the Latvian Scientific Council grants; Principal investigator, projects with Latvia, Lithuania, Estonia, Russia power systems and utilities. Developed and implemented disturbance recording systems, fault location system, protective relaying, out of step condition system for 110-330 kV transmission lines and power plants. Developed hardware and software widely used power systems in Latvia, Lithuania, Estonia, and Russia. Total number of implementation more than 500 protective relaying and automation terminals.

Corresponding Member, Latvian Academy of Sciences, 2003

Awarded with Year Prize of the Latvian Academy of Sciences and Public Joint Stock Company "Latvenergo" for life contribution in energetics and engineering, 2003.

E-mail: sauhatas@eef.rtu.lv

Edvins Vanzovichs received diploma engineer degree from Riga Technical University in 1969, PhD degree from Belarus University of Technology in 1987, Dr.Sc.Ing. degree from Riga Technical University in 1992.

He is professor of Department of Energy Supply in Riga Technical University, Faculty of Power and Electrical Engineering since 2005. Chairman of certification office of Latvian Association of Power Engineering Specialists and Energobuilders (LEEA) since 2002, Deputy dean of Riga Technical University, faculty of Power and Electrical Engineering since 1993.Main scientific interests are in fields of power supply, relay protection, automation and optimal development of electrical power networks, as well as influence of lighting on these networks.

He has more than 100 scientific publications.

E-mail: vanzovic@eef.rtu.lv

Svetlana Berjozkina, Antans Sauhats, Edvīns Vanzovičs. Augsttemperatūras vadu rentabilitātes novērtējums

Sakarā ar pārvades elektrotīkla paplašināšanas nepieciešamību pastāv iespēja izmantot pārvades elektrotīkla esošo infrastruktūru ar maksimālu jauno tehnoloģiju attīstību un pielāgošanu esošajās elektropārvades līniju sistēmās ar mazākām ekonomiskām investīcijām un augstu tehnisko drošumu. Augsttemperatūras vadu izmantošana ir nozīmīgs mūsdienu paņēmiens, uzlabojot un modernizējot pārvades tīklu.

Darbs veltīts dažādu augsttemperatūras un tradicionālā tipa vadu salīdzinošam novērtējumam pēc tehniskajiem un ekonomiskajiem apsvērumiem. Vadu salīdzinājums pēc tehniskajiem kritērijiem balstās, galvenokārt, uz mehānisko (vada mehāniskais spriegums, vada nokare un pieļaujamie laidumi) un termisko (līnijas caurlaides spēja un vada pieļaujamā temperatūra) ierobežojumu novērtēšanu. Kas attiecas uz vadu ekonomisko novērtējumu, tad šinī gadījumā tika analizētās kopējas elektropārvades līnijas izmaksas, kas sastāv no vadu, balstu, balsta pamatu, virteņu un to montāžas izmaksām.

Vadu rentabilitātes novērtējums tika piemērots vienam no energoobjekta „Kurzemes loks" priekšprojektēšanas posmiem, kas nozīmē, ka gaisvadu līnijas tradicionālā tipa vadi un balstu tipi bija izvēlēti jau iepriekš, atbilstoši tehniskai specifikācijai. Līdz ar to, salīdzinājumam tika izvēlēti pieci vadu tipi, no kuriem divi ir tēraudalumīnija vadi, piemēram, AS-240/32 un trīs – augsttemperatūras vadi, piemēram, "Casablanca".

Kā rezultātā, dažādu tipu vadu salīdzinošais novērtējums parādīja augsttemperatūras vadu rentabilitāti pēc tehniskajiem un ekonomiskajiem kritērijiem, aizvietojot ar tiem tradicionālā tipa vadus. Turklāt augsttemperatūras vadu izmantošana varētu būt vēl efektīvāka, ja samazinātos šādas konstrukcijas vadu augstā cena. Tajā pašā laikā šī var būt viena no pamatotām metodēm, lai palielinātu esošo gaisvadu līniju ierobežoto caurlaides spēju ar mazākām kopējām investīcijām.

Светлана Берёзкина, Антанс Саухатс, Эдвинс Ванзовичс. Анализ эффективности высокотемпературных проводов

В связи с необходимостью расширения линий электропередачи существует возможность использования существующей инфраструктуры электросети с максимальным развитием и внедрением новых технологий в существующие электрические системы с небольшими экономическими инвестициями и высокой технической надёжностью. Использование высокотемпературных проводов является важным способом улучшения и модернизации существующих энергосетей в настоящее время.

Работа посвящена сравнительной оценке различных высокотемпературных и традиционного типа проводов по техническим и экономическим аспектам. В основном, анализ проводов по техническим критериям основывается на механической (механическое напряжение в проводе, провес провода и допустимые пролеты) и тепловой (пропускная способность линии и допустимая температура провода) оценке ограничений. Что касается экономической оценки проводов, то в этом случае анализируются общие расходы на строительство линии, состоящие из затрат на провода, опоры, фундаменты опор, изоляторы и монтаж.

Оценка эффективности проводов была применена к одному из предпроектных этапов энергетического объекта "Курземес кольца", это значит, что традиционного типа провода и типы опор были выбраны заранее в соответствии с технической спецификацией. Поэтому для сравнения было выбраны пять типов проводов, два из которых стелеалюминиевые провода, такие как AS-240/32 и три – высокотемпературные провода, например, "Casablanca".

Сравнительный анализ различных типов проводов показал эффективность замены проводов традиционного типа на высокотемпературные провода по техническим и экономическим критериям. Кроме того, использование высокотемпературных проводов может быть более рентабельным, если будут снижены высокие цены проводов данной конструкции. В то же время, это может быть одним из разумных методов повышения ограниченной пропускной способности существующих воздушных линий.

.