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Uprating a 220 kV Double Circuit Transmission LINE in Romania; Study of the Possible Solutions, Technical and Economic Comparison

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Abstract — **Romania's inclusion in the European transport network and implementation of Aeolian turbines in massive groups imply increases in the transport capacity of some lines, required to transport or evacuate high powers over the existing capacities.**

To uprate the 220 kV double circuit line Bucharest South-Fundeni, its re-conductoring was considered.

In this respect, new conductors with increased ampacity and adequate equipment were proposed. Six types of conductors were analyzed and compared to the classical ACSR conductor.

The scope of this study was to investigate the feasibility of using HTLS conductors to achieve a higher rating without any modification to the existing structures or without increasing conductor sags.

Only the most important results obtained from the comparative analysis of the re-conductoring solutions are further described.

All the costs presented are calculated for one km of three-phase circuit equipped with one conductor per phase.

Costs have been estimated, with an error of +/-25%. This includes costs related to materials, construction, maintenance and power losses.

Index Terms -- **Ampacity, high-temperature conductors, Uprating, HTLS, Low sag, steady–state thermal rating, Uprating.**

I. INTRODUCTION

IN many countries, new power lines have not been built for many years and the ability of obtaining right of ways is becoming more and more difficult. Nevertheless, over the same time period, many such countries have also experienced a small but steady increase in the power consumption. It is thus becoming necessary to **uprate** the thermal power transfer capacity.

Uprating of an overhead line generally means to increase its transmission capacity, and this can be made by increasing **current rate**, **voltage level** or both [1].

The increase of current rate means the need either to increase the conductor temperature or to reconductor the line, while the increase of voltage level requires the re-insulation of the line to the new voltage level, including increasing phase to phase distances and ground clearances. The main methods and tools to uprate overhead lines are summarized in Table I.

TABLE I
MAIN METHODS FOR UPRATING

	Increasing	Method	Tool
Uprating	Current rate	Increasing temperature	Increasing height attachment point
			Re-tensioning
		Reconductoring Compact/smooth conductor	Compact/smooth conductor
			High temperature conductor.
		Special engineering methods	Statistical approach
			Real time approach
	Voltage level	Reinsulation	Adding/ substituting insulators
			Cross – arm modified
		Increasing ground clearance	Increasing height attachment point
		Increasing phase – phase distance	Retensioning
			Conversion of two to one circuit
			New tower top

One of the ways to achieve this is by **reconductoring.** This can be performed using conductors larger than the existing ones, or using conductors with the same diameter.

Increasing the thermal rating of an existing line by using a replacement conductor **larger** than the original (with lower resistance) will increase both transverse ice and wind and tension loads on existing structures. A larger conventional conductor imposing greater loads on the existing structures may reduce the reliability of the existing line, unless the structures are reinforced.

Increasing the thermal rating of an existing line by using a replacement conductor having nearly the **same diameter** as the original conductor but capable of operation at higher temperature (within existing sag clearance and loss-of-strength constraints), may avoid the need for extensive reinforcement of suspension structures.

There are several different types of high temperature, low sag conductors that can be used to increase the thermal rating of existing lines with a minimum of structural reinforcement.

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The most attractive choice of replacing the conductor depends on the design conditions of the existing line. All are a potential solution when the line thermal rating has to be increased by more than 50%.

The paper is organized as follows: the first section briefly presents the main features and classes of HTLS conductors. Section III shows the technical characteristics of the Bucharest South - Fundeni line. Section IV presents the methodology required when choosing HTLS conductors.

Section V and VI analyze and compare several HTLS conductors from the formulated technical–economic point of view, showing the possibilities and limitations of HTLS conductors when security constraints are taken into account.

II. High Temperature Conductor

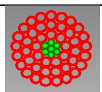
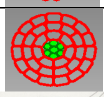
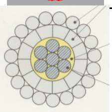
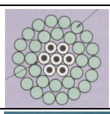
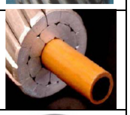
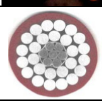
“High Temperature Conductor” is defined as a conductor that is designed for applications where **continuous operation is above 100°C** or to operate in **emergency conditions above 150°C**. [2].

Note: Emergency operating temperature is not well defined but it is generally agreed that the emergency temperature should not apply for more than 400 hours for the total life of the conductor. This relates to 10 hours per year for a 40 years life span.

These conductors fall into a category known as High Temperature, Low Sag (HTLS) conductors.

The types of conductors that are commercially available are briefly described in TABLE II. [3][4][5].

TABLE II
HTLS CONDUCTOR TYPES

ACSS	Aluminium Conductor, Steel Supported	
ACSS-TW	Trapezoidal shaped strands, Aluminium Conductor, Steel Supported	
G(Z)TACSR	Gap Type Ultra Thermal Resistant Aluminium Alloy Conductor, Steel Reinforced	
T(K)(Z)ACSR	Thermal (High Strength) (Ultra) Resistant Aluminium Alloy Conductor, Steel Reinforced	
X(Z)TACIR	Extra (Ultra) Thermal Resistant Aluminium Alloy Conductor, Invar Reinforced	
ACCR	Aluminium Conductor Composite Reinforced	
ACCC	Aluminium Conductor Composite Core	

These new conductors are made by external thermal-resistant aluminium alloy layers stranded around a core of material with a low coefficient of thermal expansion. The low coefficient of thermal expansion of the core sees that above a certain temperature, called transition temperature or knee point, the mechanical stress of the external aluminium layers is transferred to the core. From this point to the higher temperature, the whole conductor has the same mechanical behaviour of the core with resulting low increase in sag. The knee point value is linked to the aluminium/core area ratio, to the mechanical tension assumed as every-day condition and to the ruling span.

The result of this behaviour is increasing up sag to the knee point, and maintaining quite constant sag at operating temperature above the knee point. Therefore, making the comparison between the new conductors at very high temperature (150-210 °C) and the ASCR at standard temperature (70-90 °C), the difference in sag is very limited.

III. Bucharest South - Fundeni Line - Technical Characteristics

The overhead electric lines from Romania, having the nominal voltage of 220 kV, are almost all equipped with ACSR 450/75 mm^2 conductors, one conductor per phase. With this type of conductor the line can transport about 240 MVA per circuit.

To increase the power flow, the first solution to be considered is to install a new overhead line. For the new lines, the increase of the transport capacities is not an issue; it can be performed by increasing the aluminium section or by increasing the number of conductors in bundle.

However this solution has several inconvenient. First is land saturation that generates an important difficulty to get rights of way to install a new overhead line. Also, the period of time between the first moment when the need of a new line is identified, until the line is finally installed can be a decade or longer. Another problem is that a new overhead line produces an increment of visual and environmental impact. These facts make an important sector of the society to refuse the installation of new overhead lines.

Taking into account the difficulty to install new overhead lines, the second solution is to improve the existing ones. One of the most promising actions is to replace the traditional conductors for new conductors being able to work at higher temperatures without increasing sag. The installation of these conductors, generically called High-Temperature and Low-Sag conductors (HTLS conductors), doesn't require new rights of way because the operation can be considered as maintenance of the line. Also, these HTLS conductors don't increase neither visual nor environmental impact because, externally, they are very similar to traditional conductors.

Bucharest South – Fundeni line is a 220 kV double circuit steel tower line, 24.35 km long and commissioned in 1968.

The line carries one ACSR 450/75 mm^2 a conductor, originally designed for a maximum operating temperature of 70ºC with a steady – state thermal rating of 624 A [6].

To uprate the 220 kV Double Circuit Line Bucharest South – Fundeni, the reconductoring solution was taken into consideration.

IV. METHODOLOGY

The first step of the study is to define the conductor's section that allows both to increase the ampacity and to respect the constraints on the lines. In particular, the targets of the feasibility study have been:

– to increase the line's capacity approximately with 100% of the present conductors;

– to verify the compatibility of new mechanical stresses with the performance of the existing foundations and towers, meaning the new conductors should have to transmit lower tension values than the existing ones to the tower;

– to respect the clearances to the ground and obstacles stated by the Romanian law, at the new maximum operating temperature.

Identify one of each of the following High Temperature Low Sag (HTLS) conductor types for investigation:

- ACSS - Aluminium Conductor Steel Supported;
- ZTACIR - Zirconium Alloy Thermally Resistant Invar Reinforced;
- GTACSR – Gapped TAL Alloy Aluminium Conductor Steel Reinforced;
- TACSR/ACS - Thermally Resistant ACSR;
- ACCR - Aluminium Conductor Composite Reinforced;
- ACCC/TW - Aluminium Conductor Composite Core.

To maintain the line's safety in operation, for example to conserve the towers, poles or gantries and the insulating strings when using unconventional conductors (compact, HTLS), the following restrictions have to be fulfilled:

- The diameter of the new conductor has to be less or equal to the one of the existing conductor (29.25 mm);
- Conductor maximum horizontal tension (when used on Bucharest South-Fundeni line) not to exceed ACSR 450/75 mm^2 conductor tension (5362 daN) by more than 10% (to reduce impact on structures and foundations);
- The final sag of the HTLS conductors at maximum operational temperature should be limited to the final sag of the existing ACSR one (14.68 m) ;
- The conductor UTS has to be higher or equal to the one of the existing ACSR 450/75 mm^2 conductor.

The following steps were considered:

- Investigate the conductors in PLS-CADD using a representative span of 320 m. Establish the maximum operating temperatures that gives the same or less sag as the existing ACSR at 70°C.
- Investigate the feasibility of using the chosen conductors on the Bucharest South - Fundeni line with particular reference to the following aspects when compared to the existing ACSR 450/75 conductor:
  - EMF levels
  - Conductor swing
  - Maximum continuous operating temperature without loss of strength and the corresponding MVA rating.
- Estimate the total cost for design, material supply (including conductor, insulators, hardware, connectors etc) and installation, for each conductor option.

The increase in transport capacity (Ampacity by using unconventional conductors) may be observed in Table III too. The selected unconventional conductors will have to fulfil the aforementioned restrictions; therefore the replacement of the existing conductors with unconventional ones will not involve the overloading of the existing structures.

V. TECHNICAL ANALYSIS

In table III are shown the principal technical and physical characteristics that have an important impact on the following comparative calculus.

TABLE III
HTLS TECHNICAL PERFORMANCE

Type Conductor	Diameter	Unit weight	UTS	Op. Temp	Amp.
	(m)	(kg/m)	(daN)	(°C)	(Amp)
ACSR 450/75	**29.25**	**1.828**	**154.22**	**70**	**624**
ACSS/TW/HS Canary	28.15	1.691	117.43	210	1629
ZTACIR 410	27.4	1.687	127.20	210	1405
TACSR 410	28.50	1.578	139.50	150	1271
GTACSR Drake	27.80	1.616	149.20	210	1519
ACCR 824	28.60	1.384	146.06	210	1595
ACCC/TW Drake	28.15	1.530	182.80	210	1737

Along with conductors with increased ampacity, the table includes the "classical" ACSR conductor to allow the comparison of the higher ampacity conductors to this one.

The calculations of steady-state thermal rating, given a maximum allowable conductor temperature, weather conditions, and conductor characteristics were performed by the computer using PLS CADD based on the IEEE Std 738-1993.

For steady – state thermal rating, the following parameters were adopted:

- Wind speed: 0.6 m/s;
- The angle between wind and conductors: 45°;
- Emissivity and solar absorptivity: 0.5;
- Air temperature: 40°C;
- Latitude: 45°;
- Altitude above sea level: 90 m.

Based on the average Bucharest South - Fundeni span length of 320 m, the sag and blow-out of the various conductors have been calculated. The crept stringing tension has been matched to the existing tension in the ASCR 450/75 mm^2 to ensure that the towers will not be overloaded.

The Initial tension has been checked against table 6.3 "Overhead conductor safe design tension with respect to aeolian vibrations" – Cigre Task Force B2.11.04, June 2005 to ensure there will be no issues with Aeolian Vibration when the conductor is first installed.

Table IV shows the calculated physical parameters for the selected High Temperature Conductors. [7].

TABLE IV
HTLS PHYSICAL ACTUAL PARAMERTERS

Type Conductor	Max. permissible tension	Max. Operating Temperature	Sag at Max. Op. Temp.
	(daN)	(°C)	(m)
ACSR 450/75	5362	**70**	**14.68**
ACSS/TW/HS Canary	5362	200	14.68
ZTACIR 410	5362	210	14.68
TACSR 410	5362	120	14.68
GTACSR Drake	5362	200	14.68
ACCR 824	5362	210°C	14.2
ACCC/TW Drake	5362	210°C	13.76

It can be seen that in all cases the sag and the maximum permissible tension of the chosen conductors is less than of the existing ACSR 450/75.

The possible current flow achievable with the use of high temperature conductors is given in Table V below. These are Gross Power summer ratings (40°C ambient, 0.6 m/s wind).

TABLE V
HTLS, ACTUAL CURRENT FLOW

Type Conductor	Op. Temp	Ampacity	Gross Power	Report
	(°C)	(Amp)	(MVA)	-
ACSR 450/75	**70**	**624**	238	1
ACSS/TW/HS Canary	200	1583	603	2.53
ZTACIR 410	210	1405	535	2.24
TACSR 410	105	979	373	1,56
GTACSR Drake	190	1433	546	2,29
ACCR 824	210	1595	608	2.55
ACCC/TW Drake	210	1737	662	2.78

Within the constraints of keeping the clearances and tensions similar to the existing line, the advantage of thermally resistant ACSR cannot be utilized. Therefore TASCR 410 offers no advantages over the existing conductor taking in consideration the desideratum to double the power.

A. Magnetic Field

In addition to making lines safe, other important constraints are the level of electric and magnetic fields produced (e.g. electric fields increase as the conductor gets closer to the ground), the maximum structure loads during occasional high wind and ice loads, and the maximum temperature at which the energized conductors are allowed to operate.

The increase in current made possible by the use of high temperature conductors will increase the magnetic field generated by the line. As there is no change in voltage, there is no change in the electric fields [8].

The Fig.1 below shows magnetic field levels at various ratings. All are within the ICNIRP levels. These plots are highly conservative as they are based on the mid span sag point and an assumed 100% current in each circuit. In reality the system would be operated at maximum of approximately 50% of capacity and could rise up to 100% only when one circuit is out of service.

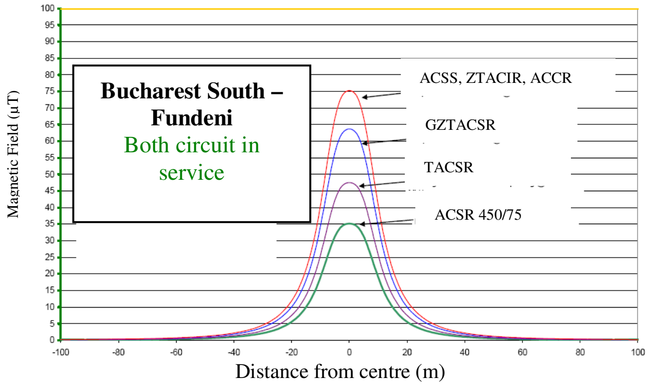


Fig. 1 – Magnetic Field Profile Comparison of High Temperature and Standard Conductors

B. Visual Impact

In order to ensure that there is very little change in the visual impact of the line, the conductors assessed have similar diameters to the existing ACSR 450/75 mm^2 and the lines have been sagged to match the sag and swing as closely as possible to the existing ones.

C. Feasibility

The stringing of conductors over heavily built up areas and a large number of roads will incur significant hurdling costs and other construction difficulties. In order to maintain safe stringing practices, outages of both circuits on the Bucharest South-Fundeni line may be required during stringing. If there is a requirement for one circuit to be continually in service, then a detailed study will be required to determine suitable stringing practices that will include input from the Transmission System Operator (TSO) and local maintenance contractors. This is expected to result in additional costs to the stringing works, in the form of special construction practices, as well as increased risk. Sign-off from higher management is likely to be required with respect to the increased risk profile associated with stringing within close proximity of live conductors.

The analysis outlined in this document takes into consideration the HTLS technology currently available in use throughout the world [9] [10] [11] [12].

D. Conclusion

From technical point of view all the chosen conductors, except the thermally resistant ACSR, can double the capacity and can be consider a feasible option.

VI. Economic Analysis

The aim of the analysis is to present the consumer a limit of the costs that resulted from:

- direct costs (initial investment, installation and maintenance);
- power losses expenses as a result of operating

conductors at high temperatures.

For calculating the initial investment, the costs of conductors, accessories and installation were considered in Table VI together with some additional technical characteristics.

TABLE VI
HTLS CONDUCTORS PRICES

Conductor type	Max. Op. Temp. (^{0}C)	Rated sag at max. operating temperature	Installation work	Material cost
ACSR	90	1	normal	1
ACSS	200	1	normal	1.1-1.5
GZTACSR	200	1	special	2.0
ZTACIR	210	1	normal	3.5
ACCC/TW	210	0.94	normal	5…7
ACCR	210	0.97	normal	10.0

Note: the price of the accessories specific to the conductor (suspension clamp, tension clamp, repairing sleeve, dampers, etc) is included in the cost of the materials.

For the economic analysis of the reconductoring solutions with conductors with higher ampacity, the variants of equipment using those conductors that have met the technical requirements needed for installing on the line have been studied comparatively in terms of building up the corresponding increase in transport capacity. All cost is given per km for one circuit.

For power losses calculation, a target ampacity of 1260A (corresponding to a 200% power flow increase) was assumed. Conductor temperature at target ampacity was calculated using PLS CADD subroutine for each conductor type. The relative resistance at this temperature was used in Power Loss calculation (see table VII) [13] [14].

TABLE VII
POWER AND POWER LOSSES

Cond. type	Amp.	Temp.	R	Gross Power	Power Loss	Net Power
	(A)	(^{0}C)	(Ω/km)	(MW)	(MW)	(MW)
ACSS Canary	1260	136.6	0.091	480	**10.6**	**469.0**
ZTACIR 410	1260	171.6	0.129	480	**14.9**	**464.6**
GZTACSR Drake	1260	151.9	0.111	480	**12.9**	**466.7**
ACCR 824	1260	141.1	0.099	480	**11.5**	**468.0**
ACCC/TW Drake	1260	125	0.079	480	**9.2**	**470.4**

Note: - All the columns (temperature, resistance R, gross power, power losses and net power were calculated at target ampacity specified in column
- Power factor assumed to be unity.

As expected, the conductor with the lowest electric resistance (ACCC/TW) offers the lowest power losses. The ACSS conductors follow, the values being 16% higher than the previous ones. The losses are shown in Fig. 2.

The use of a lower resistance conductor has two advantages - losses are reduced and operating temperatures remain modest.

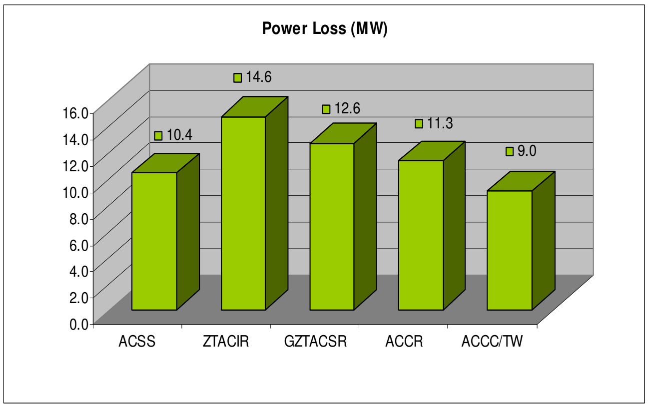


Fig. 2 Power Loss for one circuit, 24.35 km length (MW)

Assuming (maximal) an 8760 hours per year at 480 MW power flow, the actualized costs of power losses are as in figure 3 (actualized for 30 years, at an 8% rate).

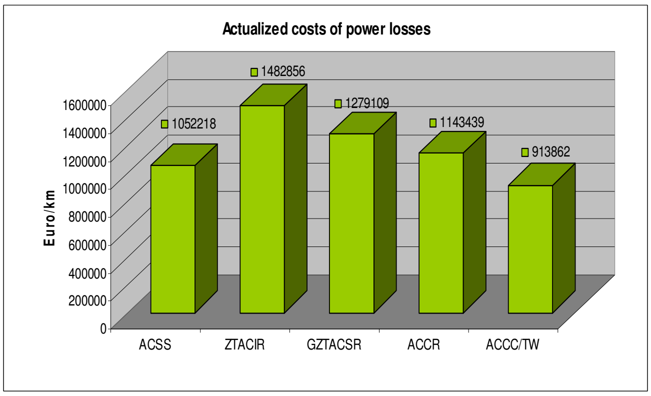


Fig. 3 Actualized costs of power losses for 30 years (Euro/km)

For direct costs (which includes procuring, installation and actualized maintenance), the minimum cost is the one for ACSS conductor that has the lowest procuring cost, and is followed by the GZTACSR conductor (Fig.4).

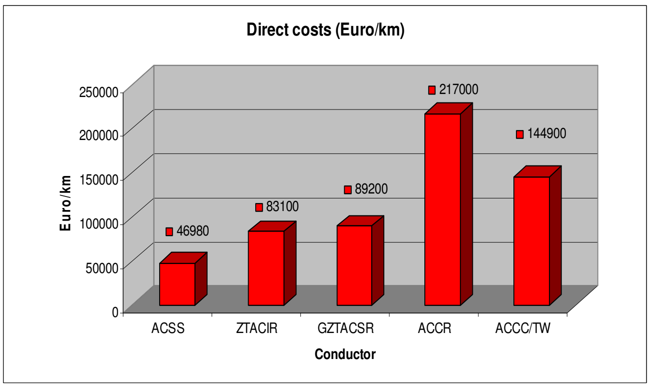


Fig. 4 Direct costs for procuring, installation and maintenance (Euro/km)

As mentioned before, because of the uncertainty on some of the entry data, of simplifying hypothesis applied for modelling some processes, of using some maximal mediated data (especially when calculating the power losses), the obtained absolute values can be distorted up to 50% compared to the real ones; however, the resulting hierarchy has a better accuracy. Both categories of costs, especially the direct ones, will be better quantified after the decision concerning the adopted solution will be taken.

Finally, if a hierarchy based on actualized total costs (losses cost + direct cost) is desired, the results obtained show the ACSS and ACCC/TW conductors as the best ones (Fig.5).

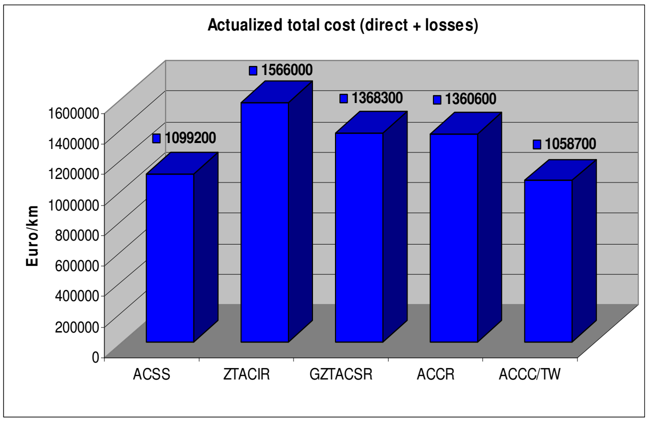


Fig. 5 Actualized total costs (Euro/km)

In the terms of substantial error fluctuations, the dispersion of the obtained values do not justify disqualifying any of the analyzed solutions at this point.

VII. Conclusion

In the uprating of power transmission lines, the concern of primary importance is public safety. It is more important that a line to be safe than to carry power. The uprated line must remain safe under all electrical power flows up to its maximum without compromising the mechanical safety under severe ice and wind loads.

The replacement of existing conductor should improve the mechanical reliability of the line since conductor, connectors, and hardware are all new.

To uprate the Bucuresti Sud – Fundeni, 220 kV double circuit line by using high temperature conductors is considered as a feasible desideratum from the technical point of view. All the selected conductors can be strung to accomplish equal or smaller sag than the initial one, but at higher temperature.

The similar diameters accomplish a minimal visual impact.

The major difference compared to the existing line is the increase of the thermal current that induces an increase in the magnetic field; however, the field remains lower than the limit value imposed by ICNIRP.

The composite type ACCC and ACCR conductors are new on the market and even if they could offer advantages when increasing the transport capacity, they have been used only in several short lines worldwide and the direct cost is higher compared to the other analyzed variants. The composite type ACCC and ACCR can represent a feasible option for TSO if the cost will be accepted.

The ZTACIR conductors are used in Japan and Korea, while the ACSS conductor becomes the most common one in USA. The direct cost of these conductors is lower than of the composite type ones; also, when considering the reduced ice load on the lines in Bucharest area, these types of conductors can be considered as feasible solutions.

Because of the low tension used for the initial stress of the conductors and of the ice loads in Bucharest area, the ZTACIR type of conductor seems to be suitable for Bucharest Sud – Fundeni LEA 220kV d.c.

The GZTACSR conductors can be considered as feasible variants; however they require special installing costs 25% more expensive than the classical one, training and expensive maintenance costs.

Finally, from the technical point of view, may be considered as feasible the following conductors: ACSS, ZTACIR, GTACSR, ACCR, and ACCC/TW.

From the detailed economical analysis that also considers the costs of power losses, the most attractive solutions are ACCC/TW and ACSS. Because of the high price and low experience in maintenance of the ACCC/TW, TSO decided reconductoring the line with ACSS.

Many millions of pounds of ACSS have been installed and are successfully operating in the United States. Most of the initial concerns about installation and surface roughness problems due to the use of annealed aluminium strands have passed. The main limitation with ACSS is its relatively low strength and modulus that may limit its application in regions experiencing high ice loads.

The use of ACSS/TW can offset this problem to some extent as can the use of extra high strength steel core wires. The conductor and special connectors designed for it allow continuous operation at temperatures up to 200°C with conventional galvanized steel core wires. The conductor can be operated above 200°C if Alumoweld or special zinc “Galfan” coated steel is used.

VIII. References

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IX. BIOGRAPHIES

Elena Mateescu was born in Bucharest, Romania, on October, 26th, 1959 and received a Dipoma in Electric Power Engineering in 1983 from Polytechnic University Bucharest, Romania. Her employment experience includes the Institute of Power Studies and Design, Bucharest and Fichtner Engineering Ltd, Bucharest. Her special fields of interest include the design of power transmission lines, electromagnetic field effect of electric network on biological systems, environmental impacts and live-line maintenance methods.

Daniel Marginean was born in Bucharest, Romania, on October, 12th, 1964 and received a Diploma in Electric Power Engineering in 1991 from Polytechnic University Bucharest, Romania. His employment experience includes the Institute of Power Studies and Design, Bucharest and Fichtner Engineering Ltd, Bucharest. His special fields of interest include the design of power transmission lines. As a specialist for transmission lines, Mr. Marginean has excellent technical capabilities related to transmission line routing, transmission line components like conductors, optical cables, insulators and supports, structural steelwork and foundations for transmission line towers, and special technical solutions PLS-Cadd abilities.

Georgel Gheorghita was born in Ramnicelu, Romania, on May, 3rd, 1948 and received a Diploma in Electric Power Engineering in 1971 and a Doctor's degree in High Voltage Engineering in 1991, both from Polytechnic University Bucharest, Romania.

His employment experience includes the Institute of Power Studies and Design, Bucharest and Fichtner Engineering Ltd, Bucharest. His special fields of interest include the design of power transmission lines, electromagnetic field effect of electric network on biological systems, environmental impacts and live-line maintenance methods.

He has Memberships in Professional Societies: Member of CIGRE – B2 Overhead Transmission Lines ,Member of CIGRE - SC 22 – WG 08 Structure and IEC, Romanian branch: Overhead Transmission Lines.

Ecaterina Dragan was born in Bucharest, Romania, on April, 3rd, 1954 and received a Diploma in Electric Power Engineering in 1978 from Polytechnic University Bucharest, Romania. Her employment experience includes the Institute of Power Studies and Design, Bucharest and Fichtner Engineering Ltd, Bucharest. Her special fields of interest include the design of power transmission lines, electromagnetic field effect of electric network on biological systems and environmental impacts and live-line maintenance methods.

She had Memberships in Professional Societies: CIGRE, Group 22, WG 15 - Life Cycle Assessment; 2000-2004.

Stelian Iuliu Alexandru Gal was born in Jimbolia, Romania, on July, 2nd, 1947 and received a Diploma in Electromecanical Engineering in 1970 and a Doctor's degree in Digital Distance Protection for Power Systems in 1994, both from Polytechnic University Timisoara, Romania. His employment experience include: Romania National Power Grid Company "Transelectrica"- S. A. – Sibiu Regional Branch and Headquarter, Romania. His special fields of interest include the live-line maintenance work technologies and different protection systems of electric network.

Constantin Matea was born in Tomsani, Romania, on August, 19, 1950 and received a Dipl. in Electromecanical Engineering in 1993 from University Politehnica Bucharest, Romania. His employment experience includes the MEE ICMP - CELPI S.A. and Romania National Power Grid Company "Transelectrica"- S.A**,** Bucharest. His special fields of interest include the live-line maintenance work technologies and different protection systems of electric network. As a Project Manager for transmission lines Mr. Matea has excellent technical capabilities related to transmission line components like clamps and fittings, conductors, optical cables, insulators and supports, structural steelwork and foundations for transmission line towers.