TECHNO-ECONOMICAL COMPARISON OF ALTERNATIVE USAGE OF Al-Fe CONDUCTORS AND ABC BY CONSTRUCTING OVERHEAD 10 kV LINES

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SUMMARY

This paper presents the results of techno-economical comparison of alternative usage of Al-Fe conductors and arial bounded conductors (ABC, in further text) by overhead 10 kV lines planning, projecting and constructing. This analysis was done by the and of 2004, in Departments for Projecting and Network Planning of PD »Elektrodistribucija-Beograd« (EDB). Variant solutions on a real overhead 10 kV line's section were compared, as well as variants on idealized runs for maximal spans of lines with ABC and Al-Fe conductors, re-calculated on the length of the analized run's section of that particular, overhead line. The whole analyses was repeated in the beginning of year 2006, with updated prices, got from Company »Elektrodistribucija izgradnja« (EDI), Belgrade. Repeated comparison was necessary, because meanwhile the prices have been changed, not only their absolute values, but also relative proportions of some materials and equipment's prices. First of all, that was the case with Al-Fe and ABC 10 kV itself. This paper presents the results of both analysis, first and repeated one. There is also a comment about the influence of prices fluctuations on the results obtained with those analysis. At the and, the paper gives appropriate conclusions concerning choice between Al-Fe conductors and ABC, due to this analysis results, but also depending on possible situations and conditions on runs of overhead 10 kV lines.

INTRODUCTION

The goal of this comparative techno-economical analysis was to check/determine the reasons, relevant for the choice of planers and project engineers between Al-Fe conductors and ABC for overhead 10 kV lines.

This analysis was done on one typical section of overhead 10 kV line „Barajevo, Glunčevo brdo“, on one particular wiredraw field, between poles No. 3 and No. 9 (marked so, by EDB's technical documantation for that line, lit [11]).

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METHOD ELABORATION

The basis for techno-economical analysis were equipment lists and correspondent prices evaluations, created for two basic variants of projecting solutions of that particular 10 kV line: first – with usage of Al-Fe conductor and second – with ABC 10 kV. Originally, the prices accesible to EDB's Projecting Department in autumn 2004, were used. For repeated analysis, at the beginning of 2006, the prices od EDI were used. Basic technical data are shown in Schedule 1.

SCHEDULE 1 – INPUT OF TECHNICAL DATA FOR BASIC VARIANTS

	Variant 1	Variant 2
conductor	Al-Fe rope 3x50/8 mm^2	ABC XHE48/O-A 3x70/16+50/19(E-AlMgISi) mm^2
maximal working strain, σ_m	7 daN/mm^2	20 daN/mm^2
poles	concrete, with arm.	concrete, with armature
poles hight	12 m	9 m
poles ground connection	exists	not exists
normal additional load from mist, ice and snow, n_{do}	1,6 g	1 g
conductor specific weight, g	196 kg/km	2575 kg/km
Wind presure, p_v	75 daN/m^2	60 daN/m^2

Chosen ABC 10 kV for second variant is correspondent to maximal current load of Al-Fe 50/8 conductor, addopted in the first case. Mechanical load capacity of the poles were calculated and different in diverse variants (and subvariants, – see Schedules 2 to 7, in Appendix A). For each (sub)variant, appropriate and complete technical documentation were done, which includes all calculations, prescribed with valid technical regulations (standing rules and recommendations related to overhead medium voltage lines projecting), Lit. [1] do [10]. Thus, for variant of 10 kV line with Al-Fe conductors, beside calculations of poles (including foot-stall calculations) and equipment per poles positions, also the calculations of poles ground connection systems were done, as well as flexure and conductors distances in the middle of each span. For the network built with ABC 10 kV, it is not necessary to ground poles. Therefore for that variant, only the poles and equipment calculations were done. The choise of mechanical forces, for all (sub)variants, were done according to Lit [7] i [8].
By this occasion, only investment costs (for building lines) were considered. Exploatation costs and their actualization were not taken into account in this analysis. In the conclusions, however, a single remark is given concerning this matter, as well as global comparison lines with ABC and Al-Fe conductors, depending on realistic conditions on possible runs of lines (feeders).

Feeder's run – realistic state on terrain and idealized cases (subvariants). For chosen feeder is typical that on its run already existed overhead low voltage (1 kV) grid, on 9 m high poles. Therefore planned overhead line on new, 12 m high poles, is mixed, calculated for both, 10 and 1 kV network. Therefore, in both basic cases (usage of Al-Fe conductors and ABC), all spans and pole positions are the same, because of mounting on the same poles the 1 kV grid, too. In the analysis elaborated here, however, the costs for 1 kV network itself, were not taken into account, because they are invariant. Only variants of poles building and 10 kV networks elements mounting on them, were compared.
In further comparison of real and idealized lines, however, it has been taken into account if they were really »mixed« or »clean« 10 kV, without 1 kV grid on their poles. Therefore were done and compared also the subvariants of constructing the »clear« 10 kV line longways the same, particular run – with different characteristics and positions of poles, calculated for mounting only 10 kV grid. Limitations on particular run were fixed poles positions 3, 6 and 9 (3 and 9 as straining, and 6 as the run's deflexion point). In the conclusions, therefore, there is an appropriate remark about »clear« 10 kV lines cases.
Finaly were also analized the cases of building 10 kV lines along completely idealized run: straight (all poles are in-line, there are no angular) and flat (horizontal, without vertical slopes – ideal run's cross-section). For Al-Fe and ABC 10 kV lines, respectively, all necessary calculations were done and building costs alongside such run were determined, at – by technical regulations approved – maximal spans of one straining (stress) field. As those spans are not the same for Al-Fe and ABC, the costs were re-calculated for the same run's length; in this analysis – the length of particular straining field of 10 kV grid on real (10 kV + 1 kV) line in Barajevo. That way, it was possible to compare also these idealized cases with previuosly elaborated, in order to make some conclusions – in which cases of realistic runs for overhead 10 kV lines is better to use Al-Fe conductors, and in which – ABC 10 kV.

RESULTS OF ANALYSIS

Necessary equipment by (sub)variants

Variants for real conditions on particular line's run. Based on calculations of forces on poles, done for each pole position on selected 10 kV line's section (straining field 3-9), results detaily presented in Schedules 2 and 3, in Appendix A, were determined.

Variants for idealized conditions (without 1 kV network) on particular line's run. In the case of »clear« 10 kV line (see Schedules 4 and 5, in appendix A), the number of necessary poles decrease, with the limitation mentioned above (final poles of straining field and poles on run's distorsion points, must be the same as in the previous case).

Variants for idealized line's run (unbarred, flat and without 1 kV network). For variants with idealized, straight and flat 10 kV line, without 1 kV network, with maximal possible length of straining field, results are presented in Schedules 6 and 7, in Appendix A. Maximal length of straining field by single-system medium voltage overhead line, executed with Al-Fe conductor, is 2000 m (according to TP-10b, Lit. [7]). Maximal distance between poles with horizontal disposition of conductors is 106 m. Therefore, in a straining field of 2000 m, there will be 19 spans (i.e. 20 pole positions, see Schedule 6, in appendix A). Maximal straining field by single-system medium voltage overhead line, executed with ABC, is 400 m (according to TP-10b, Lit. [7]). Maximal distance between poles is 47 m. Therefore, in a straining field of 400 m there will be 9 spans (i.e. 10 poles positions, see Schedule 7, in Appendix A).

Investment costs by (sub)variants

Costs of variants for particular line's run realistic conditions. Prices estimation for variant solutions on particular run and for really existing conditions on it, is shown in Schedules 8 (with Al-Fe) and 9 (with ABC), in Appendix B. In both cases, the prices are for poles and 10 kV grid, without purchase and mounting of 1 kV network. Schedule 8 and 9 show that, bacause of prices disparities and changes, in November 2004 was cheaper (cca 4900 EUR/km) to build this particular feeder using Al-Fe conductors. On the contrary, at the beginning of 2006, became reverse – it was more opportune to build ABC line (cca 5750 EUR/km). That was so, inspite the fact that Al-Fe price was reduced 47%, and ABC 41%. Namely, the price for poles 12 m height increased much more then the price for those of 9m height, caused by armature price increase. In those two Schedules, as well as in following ones, relative changes of all unit prices are given in the far right columns.

Costs of variants for idealized conditions (without 1 kV netwotk) on particular line's run. Similar to previous, also in variant of »clean« 10 kV lines (Schedules 10 and 11, in Appendix B), the result was that in Nov. 2004, for 7350 EUR/km was cheaper to build Al-Fe line, and in 2006 better was the variant with ABC, for cca 1540 EUR/km. It should be marked also that in 2004, in the case od »clean« 10 kV line, advantage of Al-Fe over ABC was greater, i.e. that the advantage of ABC now is lesser then in the case of building real, (10+1 kV) line.
It is interesting that the building costs of »clean« 10 kV overhead lines, got by prices updated in 2006 (right columns in Schedule 10 and 11), correspond to summary investment costs of them. Those prices comprise also the projecting and terrain costs, costs of solving property relations and obligations, etc. Namely, for types and cross-sections analized here, Al-Fe 50 and ABC 70 mm^2, values of 30.000 i 28.000 EUR/km, respectivelly, figurates as summary investment costs of average overhead 10 kV feeder. In Network Planning Department of EDB those values are used as input data in PC program PRAO, for techno-economical analysis of distributing network development variants.
This analysis therefore confirmed a slight advantage of ABC over Al-Fe, by their usage in the case of average, »clear« 10 kV line in realistic conditions. The cost difference between them was confirm, too.
It s important to say also that the prices used as input for PRAO were based on summary investment costs of great number of closed investment objects of EDB, after putting them into operation. Those data have Investment Department of EDB. That methodology is based on really spent money. That fact makes it completely opposite to methodology of future costs (based on equipment lists and costs estimation), applied and described in this paper. Concerning the fact that both methodologies, (second one by prices in 2006), for both 10 kV lines variants, give similar and mutually correspondent results,

with quite certaincy those results can be used as reliable for further analysis and conclusions. Concerning prices from the end of 2004, it is obvious that some of them were updated, but some of them were not. Therefore great disparities among them occured, and summary costs, based on them, can not be used for making conclusions. Namely, at the market really happened some price reduces of conductors, first of all of Al-Fe, but price changes calculated here (see far right columns in Schedules 8 to 13), are often unrealistically high and unequal, which indicates also a possibility that (some) prices used in November 2004 was not updated for a long time.

Costs of variants for ideal line's run (unbarred, flat, without 1 kV network), Opposite to previous two variants, in the case of straight run of »clean« 10 kV line in a lowland, the usage of Al-Fe is assurely more convenient; based on prices from the beginning of 2006 – for 8700 EUR/km, and from the end of 2004 – for even 14900 EUR/km.

Investment costs comparison, by (sub)variants

The costs of all 6 subvariants, comprised with this analysis (first in 2004, as well as repeated, 2006) are presented in Figure1. Comparison of price estimations in 2006 gives following results:
- Overhead 10 kV line in urban area, with 1 kV network on the same poles, is cca 26 % more expensive if 10 kV grid is done with Al-Fe conductors (variant with ABC is 20,6 % cheaper).
- In the variant without 1 kV network, (i.e. with maximal possible spans at the same, particular run), feeder with Al-Fe is only 7,35 % more expensive then ABC line (i.e. with ABC it is 6,85 % cheaper).
- Overhead 10 kV line without 1 kV grid, with straight and unbarred run in a lowland, if it is built with Al-Fe conductors, is even 46,8 % cheaper than ABC line (i.e. ABC feeder is 88 % more expensive).

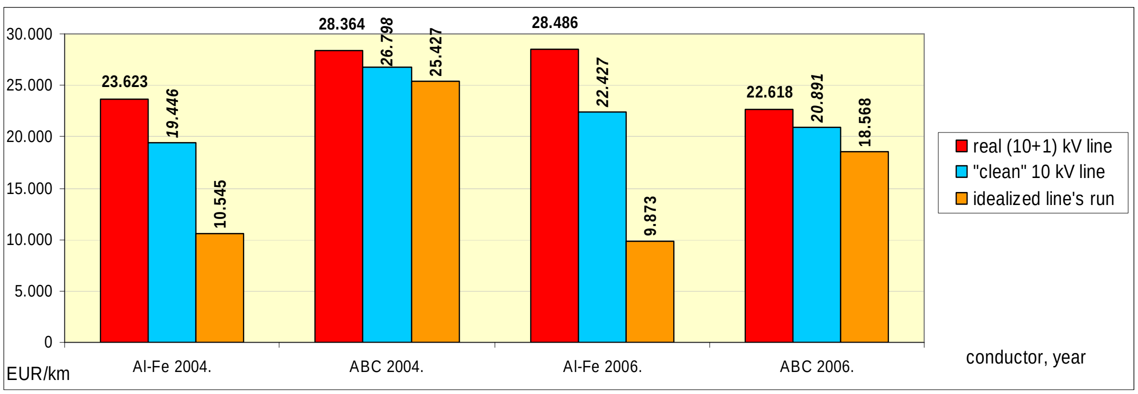

Figure 1 – Graphical representation of variants comparison results, based on 2004 and 2006 prices

More other factors and criteria affect on conductor choice. The most important is line location, i.e. if it is possible at all to build the grid with Al-Fe rope, regards to safety distances (f.e. in urban zones), if the line is situated on ”clean” terrain or in the wood (Al-Fe demands wider run and permanent maintenance i.e. shortening of branches, which represents additional costs during line's operation).
For realistic case of urban zone and positioning of line 1 kV at the same poles with 10 kV line, if the costs of mounting 1 kV grid would be calculated in, too, relative difference (in %) between summary prices of such mixed line's variants with Al-Fe and ABC 10 kV decreases additionally. However, concerning the presence of illegal object building and post festum endangering overhead line's runs, the conclusion is that in urban zones is better to use ABC 10 kV by building overhead (10+1) kV lines.

CONCLUSION

This paper presented analysis and comparison of investment costs of overhead 10 kV lines, in alternative variants of usage Al-Fe conductors and ABC 10 kV, on the example of one particular, real line's run. Beside them, the sub-variants of idealized runs were examined, too, re-calculated on the same feeder's length. Results of this analysis and conclusions derived from them, could be a signpost to planning and project engineers, for right choice of type and cross-section of overhead 10 kV lines.
The paper shows that is better to use Al-Fe conductors only in the cases of longer lines outside urban zones, on unbarred and topologically simpler runs, when there is usually no need to mount the 1 kV

network on the same poles. The lines with ABC 10 kV are – except economical – also from operational and safety reasons better in cases of building mixed (10+1 kV) overhead lines and in urban zones. General conclusion of this analysis is that overhead 10 kV lines should be built with Al-Fe conductors only where it is physically possible and economically payroll, which is left for analysing and decision making, after reconsideration all conditions and criteria, for each, particular feeder, itself.

LITERATURE

1. Pravilnik o tehničkim normativima za elektroenergetska postojenja nazivnog napona iznad 1000 V, "Sl. list SFRJ", br. 4/74, 13/78 i "Sl. list SRJ", br. 61/95-30.
2. Pravilnik o tehničkim normativima za uzemljenja elektroenergetskih postojenja nazivnog napona iznad 1000 V, "Sl. list SRJ", br. 61/95-30.
3. Pravilnik o tehničkim normativima za zaštitu niskonaponskih mreža i pripadajućih transformatorskih stanica, "Sl. list SFRJ", br. 13/78 i "Sl. list SRJ", br. 37/95-1.
4. Pravilnik o tehničkim normativima za izgradnju nadzemnih elektroenergetskih vodova nazivnog napona od 1 kV do 400 kV, "Sl. list SFRJ", br.65/88-1617 i "Sl. list SRJ", br. 18/92-265.
5. Pravilnik o tehničkim normativima za izgradnju niskonaponskih nadzemnih vodova, "Sl. list SFRJ", br.6/92-58.
6. Pravilnik o tehničkim normativima za zaštitu objekata od atmosferskog pražnjenja, "Sl, list SRJ", br,. 11/96-8.
7. Technical Recommendations TP-8, TP 10-a, TP 10-b, Zbirka tehničkih preporuka ED Srbije, 2001.
8. Internal Standards IS EDB S.B1.1.100/00 i IS EDB S.B1.2.100/00 PD "Elektrodistibucija Beograd".
9. Catalogues of EDB: Equipment and accessories for overhead lines, Protection equipment.
10. Komentar pravilnika o tehničkim normativima za izgradnju nadzemnih elektroenergetskih vodova, GSE 44/80.
11. Project: "BSTS 10/0,4 kV; 250 kVA, Barajevo-Glunčevo brdo sa uklapanjem u mrežu 10 i 1 kV" - Elektrodistribucija Beograd.
12. Nenad Stanišić, decembar 2004, “Tehno-ekonomska analiza upotrebe Al/č provodnika i SKS-a u izgradnji nadzemnih vodova 10 kV“, examination work, Viša elektrotehnička škola, Beograd.

APPENDIX A – NECESSARY EQUIPMENT, BY (SUB)VARIANTS

SCHEDULE 2 – POLES LIST FOR »MIXED« (10+1 kV) LINE WITH Al-Fe CONDUCTORS 10 kV

Pole No.	Pole type	Pole height (m)	Calc. force at pole summit (daN)	Test. force at pole summit (daN)	Pole No.	Span (m)
3	LZ	12	726,89	1000	2-3	16
4	LN	12	120,10	315	3-4	32
5	LN	12	120,10	315	4-5	31
6	UN	12	411,00	630	5-6	32
7	LN	12	139,97	315	6-7	43
8	LN	12	137,97	315	7-8	40
9	UZ	12	726,89	1000	8-9	41
					9-10	45

SCHEDULE 3 – POLES LIST FOR »MIXED« (10+1 kV) LINE WITH ABC 10 kV

Pole No.	Pole type	Pole height (m)	Calc. force at pole summit (daN)	Test. force at pole summit (daN)	Pole No.	Span (m)
3	LZ	9	637,10	1000	2-3	16
4	LN	9	153,00	315	3-4	32
5	LN	9	153,00	315	4-5	31
6	UN	9	416,06	630	5-6	32
7	LN	9	189,90	315	6-7	43
8	LN	9	196,30	315	7-8	40
9	UZ	9	637,10	1000	8-9	41
					9-10	45

SCHEDULE 4 – POLES LIST FOR »CLEAN« 10 kV LINE WITH Al-Fe CONDUCTORS 10 kV

Pole No.	Pole type	Pole height (m)	Calc. force at pole summit (daN)	Test. force at pole summit (daN)	Pole No.	Span (m)
3	LZ	12	726,89	1000	2-3	16
4´	LN	12	150,92	315	3-4´	47
6	UN	12	413,99	630	4´-6	47
7´	LN	12	180,80	315	6-7´	62
9	UZ	12	726,89	1000	7´-9	62
					9-10	45

SCHEDULE 5 – POLES LIST FOR »CLEAN« 10 kV LINE WITH ABC 10 kV

Pole No.	Pole type	Pole height (m)	Calc. force at pole summit (daN)	Test. force at pole summit (daN)	Pole No.	Span (m)
3	LZ	9	637,1	1000	2-3	16
4´	LN	9	209,8	315	3-4´	47
6	UN	9	443,2	630	4´-6	47
7	LN	9	189,9	315	6-7	43
8	LN	9	196,3	315	7-8	40
9	UZ	9	637,1	100	8-9	41
					9-10	45

SCHEDULE 6 – POLES LIST FOR STRAIGHT AND »CLEAN« 10 kV Al-Fe LINE IN A PLAIN

Pole type	Height	Number of poles	Calc.mechan. force	Tested force	Span
LZ	12 m	2	788,00 daN	1000 daN	105,3 m
LN	12 m	18	299,22 daN	315 daN	105,3 m

SCHEDULE 7 - POLES LIST FOR STRAIGHT AND »CLEAN« 10 kV ABC LINE IN A PLAIN

Pole type	Height	Number of poles	Calc.mechan. force	Tested force	Span
LZ	9 m	2	637,1 daN	1000 daN	44,4 m
LN	9 m	8	200,3 daN	315 daN	44,4 m

APPENDIX B – INVESTMENT COSTS (EQUIPMENT LISTS AND PRICES EVALUATIONS), BY (SUB)VARIANTS

SCHEDULE 8 – LIST AND COSTS FOR REAL 10 kV LINE WITH Al-Fe CONDUCTORS 10 kV

		Prices in Nov. 2004.		Prices in 2006.		Price change (%)
Equipment element	Quantity	Price per unit	Sum (CSD)	Price per unit	Sum (CSD)	
Concrete pole 12/315 (LN) with necessary equipment and allocation	4 pieces	35.600 CSD/p.p.	142.400	57.991 CSD/p.p.	231.964	+62,896
Concrete pole 12/630 (UN) with necessary equipment and allocation	1 piece	44.500 CSD/p.p.	44.500	75.848 CSD/p.p.	75.848	+70,445
Concrete pole 12/1000 (Z) with necessary equipment and allocation	2 piece	59.300 CSD/p.p.	118.600	91.427 CSD/p.p.	182.854	+54,177
Al-Fe rope 50/8	140 kg	415 CSD/kg	58.100	220 CSD/kg	30.800	-46,988
Al-Fe mounting	220 m	178 CSD/m	39.160	108 CSD/m	23.760	-39,326
Sum (CSD)			**402.760**		**545.226**	**+35,372**
Sum (EUR)		*77,5* CSD/*EUR*	**5.197**	*87,0* CSD /*EUR*	**6.267**	**+20,588**
EUR/km of line			**23.623**		**28.486**	

SCHEDULE 9 – LIST AND COSTS FOR REAL 10 kV LINE WITH ABC 10 kV

		Prices in Nov. 2004.		Prices in 2006.		Price change (%)
Equipment element	Quantity	Price per unit	Sum (CSD)	Price per unit	Sum (CSD)	
Concrete pole 9/315 (LN) with necessary equipment and allocation	4 pieces	26.700 CSD/p.p.	106.800	33.044 CSD/p.p.	132.176	+23,760
Concrete pole 9/630 (UN) with necessary equipment and allocation	1 piece	29.700 CSD/p.p.	29.700	47.075 CSD/p.p.	47.075	+58,502
Concrete pole 9/1000 (Z) with necessary equipment and allocation	2 piece	35.600 CSD/p.p.	71.200	49.153 CSD/p.p..	98.306	+38,070
ABC 3x70/16+50/19	230 m	970 CSD/m	223.100	575 CSD/m	132.250	-40,722
ABC mounting	220 m	240 CSD/m	52.800	105 CSD/m	23.100	-56,250
Sum (CSD)			**483.600**		**432.907**	**-10,482**
Sum (EUR)		*77,5* CSD/*EUR*	**6.240**	*87,0* CSD/*EUR*	**4.976**	**-20,256**
EUR/km of line			**28.364**		**22.618**	

Sign marks:

LN – in-line, supporting pole

LZ – in-line, straining pole

UN – angular, supporting pole

UZ – angular, straining pole

p.p. – pole position

SCHEDULE 10 – LIST AND COSTS FOR »CLEAR« 10 kV LINE WITH Al-Fe CONDUCTORS 10 kV

		Prices in Nov. 2004.		Prices in 2006.		Price change (%)
Equipment element	Quantity	Price per unit	Sum (CSD)	Price per unit	Sum (CSD)	
Concrete pole 12/315 (LN) with necessary equipment and allocation	2 pieces	35.600 CSD/p.p.	71.200	57.991 CSD/p.p.	115.982	+62,290
Concrete pole 12/630 (UN) with necessary equipment and allocation	1 piece	44.500 CSD/p.p..	44.500	75.848 CSD/p.p.	75.848	+70,445
Concrete pole 12/1000 (Z) with necessary equipment and allocation	2 pieces	59.300 CSD/p.p.	118.600	91.427 CSD/p.p.	182.854	+54,177
Al-Fe rope 50/8	140 kg	415 CSD/kg	58.100	220 CSD/kg	30.800	-46,988
Al-Fe mounting	220 m	178 CSD/m	39.160	108 CSD/m	23.760	-39,326
Sum (CSD)			**331.560**		**429.244**	**+29,462**
Sum (EUR)		*77,5* CSD/*EUR*	**4.278**	*87,0* CSD/*EUR*	**4.934**	**+15,330**
EUR/km of line			**19.446**		**22.427**	

SCHEDULE 11 – LIST AND COSTS FOR »CLEAR« 10 kV LINE WITH ABC 10 kV

		Prices in Nov. 2004.		Prices in 2006.		Price change (%)
Equipment element	Quantity	Price per unit	Sum (CSD)	Price per unit	Sum (CSD)	
Concrete pole 9/315 (LN) with necessary equipment and allocation	3 pieces	26.700 CSD/p.p.	80.100	33.044 CSD/p.p.	99.132	+23,760
Concrete pole 9/630 (UN) with necessary equipment and allocation	1 piece	29.700 CSD/p.p.	29.700	47.075 CSD/p.p.	47.075	+58,502
Concrete pole 9/1000 (Z) with necessary equipment and allocation	2 pieces	35.600 CSD/p.p.	71.200	49.153 CSD/p.p.	98.306	+38,070
ABC 3x70/16+50/19	230 m	970 CSD/m	223.100	575,00 CSD /m	132.250	-40,722
ABC mounting	220 m	240 CSD/m	52.800	105,00 CSD/m	23.100	-56,250
Sum (CSD)			**456.900**		**399.863**	**-12,483**
Sum (EUR)		*77,5* CSD/*EUR*	**5.895,5**	*87,0* CSD/*EUR*	**4.596**	**-22,042**
EUR/km of line			**26.798**		**20.891**	

SCHEDULE 12 - LIST AND COSTS FOR STRAIGHT AND »CLEAN« 10 kV Al-Fe LINE IN A PLAIN

		Prices in Nov. 2004.		Prices in 2006.		Price change (%)
Equipment element	Quantity	Price per unit	Sum (CSD)	Price per unit	Sum (CSD)	
Concrete pole 12/315 (LN) with necessary equipment and allocation	18 pieces	35 604 CSD/p.p.	640.872	57.991 CSD/p.p.	1.043.838	+62,878
Concrete pole 12/1000 (LZ) with necessary equipment and allocation	2 pieces	59 340 CSD/p.p.	118.680	91.427 CSD/p.p.	182.854	+54,073
Al-Fe rope 50/8	1250 kg	415 CSDkg	518.750	220 CSD/kg	275.000	-46,988
Al-Fe mounting	2000 m	178 CSD/m	356.000	108 CSD/m	216.000	-39,326
Sum (CSD) for stress	field	length 2000m	1.634.302		1.717.692	
For real run's	field	(220 m), CSD	**179.773**		**188.946**	**+5,102**
Sum (EUR)		*77,5* CSD/*EUR*	**2.320**	*87,0* CSD/EUR	**2.172**	**-6,379**
EUR/km of line			**10.545**		**9.873**	

SCHEDULE 13 – LIST AND COSTS FOR STRAIGHT AND »CLEAN« 10 kV ABC LINE IN A PLAIN

		Prices in Nov. 2004.		Prices in 2006.		Price change (%)
Equipment element	Quantity	Price per unit	Sum (CSD)	Price per unit	Sum (CSD)	
Concrete pole 9/315 (LN) with necessary equipment and allocation	8 pieces	26.700 CSD/p.p.	213.600	33.044 CSD/p.p.	264.352	+23,760
Concrete pole 9/1000 (LZ) with necessary equipment and allocation	2 pieces	35.600 CSD/p.p.	71.200	49.153 CSD/p.p.	98.306	+38,070
ABC 3x70/16+50/19	420 m	970 CSD/kg	407.400	575 CSD/kg	241.500	-40,722
ABC mounting	400 m	240 CSD/m	96.000	105 CSD/m	42.000	-56,250
Sum (CSD) for stress	field	length 400 m	788.200		646.158	
For real run's	field	(220 m), CSD	**433.510**		**355.387**	**-18,021**
Sum (EUR)		*77,5* CSD/*EUR*	**5.594**	*87,0* CSD/*EUR*	**4.085**	**-26,975**
EUR/km of line			**25.427**		**18.568**	