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Review of Railway Rehabilitation in Central Asia

for Kazakhstan, Kyrgyzstan, Tajikistan and Uzbekistan

**Module B - Feasibility Study of the rehabilitation
measures for the Lugovaya – Kyrgyz Border
railway section (Kazakhstan)**

Annexes

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LIST OF ANNEXES:

ANNEX I	“Cost estimates and BoQ of the Options”
ANNEX II	“Safety devices tables”
ANNEX III	“Options schemes”
ANNEX IV	“Details of maintenance costs”
ANNEX T	“Typical drawings (alignment, permanent way, structures)”

ANNEX I

COST ESTIMATES AND BILL OF QUANTITIES

Lugovaya - Kyrgyz border section OPTIONS 1 and 2 - INFRASTRUCTURE BILL OF QUANTITIES							
N	Description	Unit	Quantity	Rate	Total Local	Total International	NOTES
	A. WORKS			USD	USD	USD	
1A	Topographic survey of the line and corrections of the existing alignment and profile	km	61,00	3 500,00		213 500,00	All the line, including stations.
2A	Demolition of line	km	60,50	975,61	59 024,39		All the line is equipped with P65 rails on wooden sleepers and Merke station equipped with P50 rails. It has been excluded the total length of switches (about 0,5 km)
3A	Excavation	m ³	172691,20	0,37	63 179,71		It includes the removal of about 0.6 m thick layer of top embankment material (ballast and sub-ballast), laying it on both sides of the embankment, profiling and compacting the top section of the embankment.
4A	Partial lateral rebuilding embankment section for 15 km, placing and compacting the removed top material for widening the top surface of about 1,0 m on both sides	m ³	81450,00	0,49	39 731,71		It includes control and correction of 3.A material granulometry, if necessary, placing and compacting the removed top material for widening the top surface of about 1,0 m. In case the embankment is 1,0m high, it consists in removing 0,15m ³ /m and adding 1m ³ /m, in case the embankment is 2,0m high, it consists of removing 0,30m ³ /m and adding 2m ³ /m. It has been considered for a line length of 15 km.
5A	Implementation of a layer of sandy gravel material, 0,2 m thick under sleepers (sub-ballast)	m ³	65485,20	0,07	4 791,60		It includes spreading, compacting and profiling section of materials.
6A	Construction of line	m	60500,00	2,15	129 823,56		It includes installation of concrete sleepers, P65 rails, fastenings, spread of ballast, tamping and lift of rails up to 3 cm to final level.
7A	Flash-butt or thermic weld of P65 rail	unit	4330,00	4,00	17 320,00		(61 km)x2/25 less joints (as calculated in 13B and 14B).
8A	Regulation of mechanical tension of long welded rails (l.w.r.)	km	121,00	300,00	36 300,00		(60.5 km)*2.
9A	Final tamping and leveling of new line	km	61,00	316,41	19 301,29		switches included
10A	Ballast cleaning on the other existing sections	km	0,00	116,62	0,00		
11A	Tamping, leveling and aligning the other existing sections with l.w.r.	km	0,00	316,41	0,00		
12A	Substitution of concrete pipes of culverts	n	0,00	200,00	0,00		
13A	Excavation of ditches	m of line	5200,00	2,00	10 400,00		Longitudinal ditches in stations.
14A	Pavement of level crossings	unit	10,00	400,00	4 000,00		Each level crossing envisages an area of 50m by 10m.
15A	Passenger stations: new platforms	m ²	0,00	24,00	0,00		No works are envisaged into stations (apart from PW works).

16A	Passenger stations: platforms restyling	m ²	0,00	16,00	0,00		No works are envisaged into stations (apart from PW works).
17A	Passenger stations: building restyling	m ²	0,00	120,00	0,00		No works are envisaged into stations (apart from PW works).
18A	Replacing switch crossings	unit	0,00	166,88	0,00		
19A	Replacing switch blades	unit	0,00	166,88	0,00		
20A	Replacing (or installation) of switch small tg (complete)	unit	1,00	333,76	333,76		Installation of 1 new P65 turnouts including the demolition of the existing P50 tg 1:11 one in Merke station
A				Subtot Local Works	384 206,01		
International manpower		man-months	20	8 000,00		160 000,00	4 months duration of works per 5 experts
Total international cost						373 500,00	
B. Materials							
1B	P65 rails (about 11 000x2 m)	t	1430,00	580,00		629 400,00	One km of new rails for Merke running track plus about 10 km of new rails for replacing the necessary sections of re-used P65 rails.
2B	Concrete sleepers	unit	115000,00	25,00	2 875 000,00		minimum 61km * 1840 = 112240
3B	Fastenings for concrete sleepers	pairs	115000,00	25,00		2 875 000,00	
4B	Ballast for renovated sections	m ³	107206,00	5,50	589 633,00		1,77 m ³ /m on straight (98%); 1,9034 m ³ /m on curve (2%) (cantilever: 75 mm).
5B	Additional ballast for existing sections	m ³		5,50	0,00		
6B	Sandy gravel on track sections (new sub-ballast layer)	m ³	65485,20	2,00	130 970,40		1,08 m ³ /m on straight; 1,2 m ³ /m on curve.
7B	Blocks for 10 level crossings	unit	240,00	50,00	12 000,00		0,24 m ³ each block. 24 blocks per L.C. Cement price 190,0 US\$/m ³
8B	Concrete pipes φ 1,5m	n	0,00	6 000,00	0,00		
9B	Concrete pipes φ 2,0m	m	0,00	700,00	0,00		
10B	Switch crossing	unit	0,00	4 000,00		0,00	
11B	Switch blades	pairs	0,00	15 600,00		0,00	

12B	Switch complete (small lg)	unit	1,00	52 000,00		52 000,00	One P50 turnout to be replaced in Merke station.
13B	Rail Joints	each	440,00	25,00		11 000,00	Minimum 51*2 insulated joints (4 joints for each insulated joints).
14B	Insulated rail joints	each	110,00	34,00		3 740,00	Minimum 51*2 insulated joints for track circuits (the line section is divided in 51 block sections)
15B	Passenger stations: platforms new	m ²	0,00	36,00	0,00		Stations are not included.
16B	Passenger stations: platforms restyling	m ²	0,00	31,00	0,00		Stations are not included.
17B	Passenger stations: building restyling	m ²	0,00	400,00	0,00		Stations are not included.
18B	Concrete ditch (pipe) for station main track drainage.	m	5000,00	25,00	62 500,00		It includes poor concrete bed and different layers of gravels for drainage. 5 km for all stations main tracks.
D				TOT MATERIALS	3 670 103,40	3 771 140,00	

ANNEX II

SAFETY DEVICES TABLES

Feasibility Study Module B

Table A - Present Station Signalling description

N°	Location (Km)	Station name	Interlocking technology	Train detector device	Electrical power supply (4)	Presence of UPS with diesel generator / power	Remote control	number of point switches electrically	present maximum allowed speed (1)	Installation Year
1	3626	Lugovaya	relay	track circuit	380V,	yes/65kva	only tracks/signal	97	80 (100)	2004-05
2	3639	P 3639	relay	track circuit	380V,	not	yes	4	80 (100)	1983-1985
3	3648,1	Munke	relay	track circuit	380V	not	yes	5	80 (100)	1983-1985
4	3666,012	Merke	relay	track circuit	380V,	yes/24kva	yes	16	80 (100)	1983-1985
5	3686,325	Chaldovar	relay	track circuit	380V	not	yes	7	80 (100)	1983-1985
	3689	Border								

Note: (1)in brachets speed before temporary present restriction

Table B - Present Line Signalling Description - Block Systems

N°	Line Section from station X to station Y	Line Section length (Km) (1)	Control over the overall traffic operation of the line (Yes/not)/from	Block system technology	Block sections number	Presence of cab signal	Present Line classification
1	Lugovaya- PI 3639	13	Yes/Bishkek1	automatic	6	Yes	Traceca
2	PI 3639 -Munke	9,1	Yes/Bishkek1	"	6	"	"
3	Munke-Merke	17,912	Yes/Bishkek1	"	9	"	"
4	Merke-Chaldovar	20,31	Yes/Bishkek1	"	10	"	"

Note : (1) distances from building axis

Feasibility Study Module B

Table C - Present Line Signalling Description - Level crossing

(Source Kyrgyz railways)

N°	Line section: from station X to station Y or station Z	Level crossings (without barriers with Saint Andrew crosses and stop not lighted sign) (Number)	Level crossings (without barriers and with light signals)/presence of operator(1) number:	Level crossings with barriers switched by trains (protected by block signals)/presence of operator(1) number:	Level crossings (with barriers protected both sides by station signals)/presence of operator(1) number:
1	Lugovaya- PI 3639		1	0	0
2	PI 3639 -Munke		1	0	0
3	Munke-Merke		1	0	1
4	Merke-Border-Chaldovar		3	0	0
5	Chaldovar-Kaindy		2	1	0
6	Kaindy-Karabalta		2	2	0
7	Karabalta-R.141	4	0	0	0
8	R.141-Belovodskaya		2	0	1
9	Belovodskaya—Shopokovo		2	0	0
10	Shopokovo-R.3766		1	0	1
11	R.3766- Bishkek 1	2	1	0	0
12	Bishkek 1 -Bishkek 2		0	1	1
13	Bishkek2-Alamedin		0	0	0
14	Alamedin-Kant		2	1	0
15	Kant- -Ivanovka	1	2	0	1
17	Ivanovka-Tokmak	1	3	1	0
19	Tokmak-Post3848km		1	1	0
21	Post3848km-Bistrovka	1	3	1	0
23	Bistrovka-Djil/Aryk		1	0	0
24	Djil/Aryk-R.148	1	1	0	0
25	R.148-Kayamat/Kurkol	1	0	0	0
27	Kayamat/Kurkol-Balykchi	1	1	1	0
28	total	12	30	9	6
29	staff needs (*)			36	24
note	(*) presence of operator when there are barriers; need: 4 Man for each crossing				
total	Lugovaya-Chaldovar		6	0	1
total	Chaldovar-Bishkek2	6	10	4	2
total	Bishkek2-Balykchi	6	14	5	3

Table D - Specifications of number of workers of the signaling system, interlocking and block signalling

Divisions and served devices	Post	Measuring	Norm of service			Norm of number on a measuring
			1	2	3	
Crew on service of the station equipment:	senior electromechanic	Part Electromechanics	6	6	6	1
devices of an electric interlocking installation of large and small stations	electromechanic	switch	25	30	33	1 *
	electrical engineer	switch	36	37	38	1
control-dimensional devices, devices of the control of the derailment of the rolling stock	electromechanic	complete set	200	200	200	1
block of power station without autostart	electromechanic	block	35	35	35	1
block of power station with autostart	electromechanic	block	11	11	11	1
Diesel engine - generating set	electromechanic	set	7	7	7	1

Feasibility Study Module B

Divisions and served devices	Post	Measuring	Norm of service			Norm of number on a measuring
			1	2	3	
Crew on service of devices of automatic block relay systems	senior electromechanic	Part Electromechanics	6	6	6	1
On a single-track site	electromechanic	km	29	32	34	1
	electrical engineer	km	58	60	62	1
On a double-track site:						
Three-value	electromechanic	km	19	20	21	1
	electrical engineer	km	38	40	42	1
Four-value	electromechanic	km	16	16	16	1
	electrical engineer	km	32	32	32	1
route - control gears	electromechanic	swith	43	45	47	1
	electrical engineer	swith	67	70	72	1
Crew for service of devices:	senior electromechanic	central post	1	1	1	1
Central control point CTC (relay system)	electromechanic	Dispatching circle	6	6	6	4
	electrical engineer	Dispatching circle	6	6	6	1
The dispatching control of relay systems	electromechanic	km	64	64	64	1

Feasibility Study Module B

Divisions and served devices	Post	Measuring	Norm of service			Norm of number on a measuring
			1	2	3	
The crew serving crossings:	senior electromechanic	Part Electromechanics			6	1
With autobarriers	electromechanic	crossing			29	1
	electrical engineer	crossing			44	1
Without an autobarrier	electromechanic	crossing			44	1
	electrical engineer	crossing			50	1
The crew of a signal system serving wires, suspended on air and power distribution circuits	senior electromechanic	Part Electromechanics			6	1
	electromechanic	km			400	1
	electrical engineer	km			800	1
The crew of a signal system serving the devices of a controlled manual block	senior electromechanic	Part Electromechanics			6	1
	electromechanic	key dep. Switch			47	1
	electrical engineer	key dep. Switch			72	1

Feasibility Study Module B

Divisions and served devices	Post	Measuring	Norm of service			Norm of number on a measuring
			1	2	3	
Crew of maintenance work of devices of an automatic cab signalling	senior electromechanic	Control point			3	1
	electromechanic	set			34	1
	electrical engineer	set			30	1
Staff system	electrical engineer	km			50	1

Notes:

1. The measuring on automatic block system and a centralized dispatching control (CTC) is accepted in kilometers of operational length
2. On sites with constant using double-track traffic on each track, norm of service to apply with factor 0,8
3. The norm of service at imposing on automatic block system of frequency track circuits is applied with factor 0,85
4. At service of devices which life time has expired from 1 year till 5 years, before their modernization, norm of service to apply with factor 0,95, after expiry of the term from 5 till 10 years and over 10 years factors are accordingly equal 0,9 and 0,35
5. Items 1 - 4 are applicable for calculation of specifications of number in repair - technological site of a signal system
6. In devices of an automatic block, a centralized dispatching control and the dispatching control (CTC) with microprocessors, the norm of service is applied with factor 1,2

Feasibility Study Module B

		Number	number for each electromechanic	number for each electric engineer	electromechanic need	electric engineer need	senior need
Switches	n °	32	33	38	0,97	0,84	
Station power blocks	n °	4	11	nn	0,36		
Diesel elec generator	n °	1	7	nn	0,14		
Manual block	n°of points	n.n.					
Level crossings with autobarriers	n°	1	29	44	0,035	0,02	
Level crossings without autobarriers	n°	6	44	50	0,14	0,12	
Automatic block	km	60	32	60	1,88	1	1
subtotal					3,525	1,98	
basic total					6,57		
equipment with life-time expired from over 10 year					plus 60%		
					3,94		
need					10,51		

Table E.1 - Maintenance needs

Lugovaya – Kyrgyz Border Section

Feasibility Study Module B

Quantities	Lugovaya(e) Chaldovar (e)	Chaldovar(i) Bishkek2(e)	Bishkek2(i) present	Balykchi foreseen	Total
Points n°	32	212	73	148	
Block section n°	31	53	no	72	
Length km	60+325	93+724	167+177		321,226

Table E.2 - Quantities

Feasibility Study Module B

Table F.1 – S.D. Alternative 2 Investments costs

Alternative 2 Lugovaya(e)-Kyrgyz border	unities of measurement	Quantities of unities	Unities prices \$	Total \$	supply quote	works quote	national quote	foreign quote
Signal System								
Interlocking								
P 3639	Whole system	4		705.000	564000	141000	70500	634500
Munke	Points n°	5	144.000	721.000	576800	144200	72100	648900
Merke	Points n°	16	50.000	800.000	640000	160000	80000	720000
Chaldovar	Points n°	7	104.000	728.000	582400	145600	72800	655200
Power Supply								
U.P.S. without Diesel gen	n°	3	22010	66.030	52824	13206	13206	52824
U.P.S. with Diesel gen 48kva	n°	0						
U.P.S. with Diesel gen 24kva	n°	1	33000	33000	26400	6600	3300	29700
Block system								
	Block section n°	31	35.000	1.085.000	813750	271250	217000	868000
Level crossing								
with lights	n°	6	31.000	186.000	130200	55800	55800	130200
with lights and barriers	n°	1	49.000	49.000	34300	14700	14700	34300
total				4.373.030	3420674	952356	599406	3773624

%	100	78	22	14	86
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Feasibility Study Module B

Table F.2 – S.D. Alternative 3 Investments costs

Alternative 3 Lugovaya(e)-kyrgyz border	unities of measurement	Quantities of unities	Unities prices \$	Total \$	supply quote	works quote	national quote	foreign quote	
Signal System									
Interlocking									
P 3639	Whole system	4		705.000	564000	141000	70500	634500	
Munke	Points n°	5	144.000	721.000	576800	144200	72100	648900	
Merke	Points n°	16	50.000	800.000	640000	160000	80000	720000	
Chaldovar	Points n°	7	104.000	728.000	582400	145600	72800	655200	
Power Supply									
U.P.S. without Diesel gen	n°	3	22010	66.030	52824	13206	13206	52824	
U.P.S. with Diesel gen 48kva	n°	0							
U.P.S. with Diesel gen 24kva	n°	1	33000	33000	26400	6600	3300	29700	
Block system									
	Block section n°	31	35.000	1.085.000	813750	271250	217000	868000	
Level crossing									
with lights	n°	6	31.000	186.000	130200	55800	55800	130200	
with lights and barriers	n°	1	49.000	49.000	34300	14700	14700	34300	
Centralised Traffic Control									
	Central Post Peripheral Places	0							
(without TLC cable)	n°	4	20.000	80.000	60000	20000	8000	72000	
total				4.453.030	3480674	972356	607406	3845624	
				%	100	78	22	14	86

Feasibility Study Module B

№	Station master	Name and class of the station	Traffic operators	Other traffic operator in help	Switchmen	senior electromechanic	electromechanic	electrical engineer
1	1	Balykchi (3)	5	1	-		1	1
2	1	Koyamat – Kurkol (5)	2	-	-			
3	1	R. 148 (5)	2	-	-			1
4	1	Djil-Aryk (4)	2	-	-			1
5	1	Bistrovka (4)	4	-	-	1		2
6	-	Post 3848	-	-	-			
7	1	Tokmak (2)	5	-	9		1	1
8	1	Ivanovka (4)	4	-	-			2
9	1	Kant (2)	5	2	9	1	1	
10	1	Alamedin (1)	5	2	10			1
11	1	Bishkek 2 (2)	5	-	-		1	1
12	1	Bishkek 1 (1)	5	4	-	1	5	4
13	1	R3766-Soklukh (4)	2	-	-	1	1	1
14	1	Shopokovo (3)	4	-	-		1	1
15	1	Belovodskaya (3)	5	-	-		1	2
16	1	R 141 (4)	1	-	-		1	1
17	1	Karabalta (2)	5	-	-			1
18	1	Kaindy (3)	5	-	-		1	1
19	1	Chaldavar(5)	1	-	-		1	1
20	1	Merke (3)	5	-	-	1	2	
21	1	Munke (5)	1	-	-			
22	1	Post 3639(5)	1					

Table F.3 - Lugovaya(e)-Balykchi:operational and maintenace work force

ANNEX IV

DETAILS OF MAINTENANCE COSTS

ANNEX IV Details of maintenance costs				
Description	Unit	Unit Cost (US\$)		
			Quantity/km	Amount (US\$/km)
Lifting Repair				
Labour	hour	1,51	2723,1	4112
Light works	m of line	-	400	0
Equipment	hour	486,40	15,0	7296
Rails R-65	tonne	580,00	13,0	7540
Turnouts	each	52 000,00	0,0	0
Sleepers	each	25,00	368,0	9200
Fastenings	couple	25,00	368,0	9200
Ballast	m3	5,50	540,0	2970
Sub-Ballast	m3	2,00	0,0	0
Earthworks	m3	4,00	30,0	120
Switch crossings	each	4 000,00	0,0	0
Switch blades	pair	15 600,00	0,0	0
Joints	each	25,00	1,0	25
Insulated joints	each	34,00	1,0	34
Pipe culverts Φ 1,5m	each 12 m	6 000,00	0,0	0
Tot net constuction cost				44 216
Tot cost with client and constructor costs		29%		57 039
Tot cost with taxes		25%		71 298
Tot cost with insurance		0,40%		71 583
Tot cost with risk coefficient		15%		82 321

ANNEX IV Details of maintenance costs				
Description	Unit	Unit Cost (US\$)	Quantity/km	Amount (US\$/km)
Medium Maintenance				
Labour	hour	1,51	4930,4	7445
Equipment	hour	486,40	40	19456
Rails R-65	tonne	580,00	39	22620
Turnouts	each	52 000,00	0	0
Sleepers	each	25,00	736	18400
Fastenings	couple	25,00	736	18400
Ballast	m3	5,50	1080	5940
Sub-Ballast	m3	2,00	33	67
Earthworks	m3	4,00	60	240
Switch crossings	each	4 000,00	0,5	2000
Switch blades	pair	15 600,00	0,5	7800
Joints	each	25,00	2	50
Insulated joints	each	34,00	1	34
Pipe culverts Φ 1,5m	each 12 m	6 000,00	0,05	300
Tot net constuction cost				110 876
Tot cost with client and constructor costs		29%		143 030
Tot cost with taxes		25%		178 788
Tot cost with insurance		0,40%		179 503
Tot cost with risk coefficient		15%		206 428

ANNEX IV Details of maintenance costs				
Description	Unit	Unit Cost (US\$)	Quantity/km	
			Quantity/km	Amount (US\$/km)
Capital Maintenance				
Labour	hour	1,51	12499,0	18873
Equipment	hour	486,40	60	29184
Rails R-65	tonne	580,00	130	75400
Turnouts	each	52 000,00	0,2	10400
Sleepers	each	25,00	1840	46000
Fastenings	couple	25,00	1840	46000
Ballast	m3	5,50	1800	9900
Sub-Ballast	m3	2,00	1080	2160
Earthworks	m3	4,00	1000	4000
Switch crossings	each	4 000,00	0,1	400
Switch blades	pair	15 600,00	0,1	1560
Joints	each	25,00	4	100
Insulated joints	each	34,00	2	68
Pipe culverts Φ 1,5m	each 12 m	6 000,00	0,1	600
Tot net constuction cost				265 500
Tot cost with client and constructor costs		29%		342 495
Tot cost with taxes		25%		428 119
<i>Tot cost with insurance</i>		0,40%		429 831
Tot cost with risk coefficient		15%		494 306

ANNEX IV Details of maintenance costs				
Description	Unit	Unit Cost (US\$)	Quantity/km	Amount (US\$/km)
Capital Maintenance without rails renewal				
Labour	hour	1,51	15 000,00	22 650,00
Equipment	hour	486,40	60,00	29 183,88
Rails R-65	tonne	580,00	-	-
Turnouts	each	52 000,00	0,20	10 400,00
Sleepers	each	25,00	1 840,00	46 000,00
Fastenings	couple	25,00	1 840,00	46 000,00
Ballast	m3	5,50	1 800,00	9 900,00
Sub-Ballast	m3	2,00	1 080,00	2 160,00
Earthworks	m3	4,00	1 000,00	4 000,00
Switch crossings	each	4 000,00	0,10	400,00
Switch blades	pair	15 600,00	0,10	1 560,00
Joints	each	25,00	4,00	100,00
Insulated joints	each	34,00	2,00	68,00
Pipe culverts Φ 1,5m	each 12 m	6 000,00	0,10	600,00
Tot net constuction cost				191 165
Tot cost with client and constructor costs		29%		246 603
Tot cost with taxes		25%		308 254
Tot cost with insurance		0,40%		309 487
Tot cost with risk coefficient		15%		355 910

ANNEX IV Details of maintenance costs				
Description	Unit	Unit Cost (US\$)	Quantity/km	Amount (US\$/km)
Capital Maintenance with only rails renewal				
Labour	hour	1,51	4 000,00	6 040,00
Equipment	hour	486,40	50,00	24 319,90
Rails R-65	tonne	580,00	130	75400
Turnouts	each	52 000,00	0,20	10 400,00
Sleepers (only 10%)	each	25,00	184,00	4 600,00
Fastenings (only 10%)	couple	25,00	184,00	4 600,00
Ballast (only 20% for refilling)	m3	5,50	360,00	1 980,00
Sub-Ballast (no)	m3	2,00	-	-
Earthworks (no)	m3	4,00	-	-
Switch crossings (no)	each	4 000,00	-	-
Switch blades (no)	pair	15 600,00	-	-
Joints (all)	each	25,00	4,00	100,00
Insulated joints (all)	each	34,00	2,00	68,00
Pipe culverts Φ 1,5m (no)	each 12 m	6 000,00	-	-
Tot net constuction cost				136 236
Tot cost with client and constructor costs		29%		175 744
Tot cost with taxes		25%		219 681
Tot cost with insurance		0,40%		220 559
Tot cost with risk coefficient		15%		253 643

When replacing only the rails, it has been assumed that also 10% of sleepers and fastenings and 20% additional ballast for refilling will be considered. For turnouts, joints and insulated joints, quantities are the same of normal Capital Maintenance.



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