MINISTRY OF REGIONAL DEVELOPMENT AND INFRASTRUCTURE OF GEORGIA

ROADS DEPARTMENT

SAMTREDIA-GRIGOLETI ROAD SECTION OF E-60 HIGHWAY

PREPARATION OF ENVIRONMENTAL IMPACT ASSESSMENT, LAND ACQUISITION, RESETTLEMENT PLAN, DETAILED ENGINEERING DESIGNS AND TENDER DOCUMENTS

LOT 1. KM 0+000 – KM 11+500

FINAL REPORT

DRAWINGS
VOLUME VII
RELOCATION OF OVERHEAD POWER LINES

PROJECT: GEORGIA EAST WEST HIGHWAY

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Explanatory Notes

Proposed engineering solutions for relocation of overhead lines crossing the Samtredia-Lanchkhuti New Road route (section KP00+000 – KP11+500) were developed on the basis of the Contract and technical task description given therein. Proposed engineering solutions include measures that allow to observe requirements of regulations on crossing of roads with 0.4kV-110kV overhead lines and permissible distances between overhead power lines and various elements of road infrastructure. Preliminary cost estimate of needed construction-installation works is also provided. Proposed technical solutions should be agreed with appropriate power transmission/distribution organizations that own the considered overhead lines. Based on Technical Conditions issued by these organizations detailed designs of crossings of I category Samtredia-Lanchkhuti new road by 0.4-110kV overhead lines should be prepared. Approval of proposed technical solutions should be obtained from the owners of the overhead lines – JSC Energo-Pro Georgia and other interested parties.

Proposed dimensions, crossing types and distances from lines to road elements correspond to requirements of the "Rules for Electric Installations" (ПУЭ – Правила устройства электроустановок) ПУЭ-2002, 7-th Edition. Crossing angle between the road and overhead lines is not specified in norms. Crossing of category I road by the overhead power lines should be arranged by means of anchored towers on both sides of crossing span (ПУЭ-2002, Article 2.5.146). Towers should have normal, standard structure. Fixing of conductors of overhead line at crossing of category I road should be made by means of two-chain stretching insulator assemblies with separate fastening of each chain to power line tower of anchored type (requirement of ПУЭ-2002, Article 2.5.96).

Distances between overhead power line conductors and road surface and distances between towers and road edges should not be less than values determined in Table 2.5.32 and should conform with requirements of ПУЭ-2002, Articles 2.5.146-2.5.149. Both vertical and horizontal normative distances should be observed.

During construction-installation works for implementation of proposed technical solutions for crossings of road with overhead lines requirements of Rules of Safety for Operation of Electric Devices should be strictly observed. Requirements of SNIP III-4-80 Rules of Construction Safety should be observed during installation works at road crossings by overhead power lines.

Construction works should be performed according to "Construction Norms and Rules III-4-80" (SNIP III-4-80) "Construction Safety Rules". During installation of overhead line conductors the distances between the power line wires and road surface should be 5-10% larger than calculated design values.

Types and foundation of 110kV overhead line towers should be designed on the basis of results of geotechnical survey.

Crossing of roads with 0,4kV-10kV cable lines and location of underground cables should conform to requirements of Articles 2.3.83-2.3.133 of ПУЭ-2002.

1. Crossing #1 (KP 15+70 – 16+10)

New road route is crossing existing 10kV overhead power line, installed on wooden posts with reinforced concrete supports. Numbering of posts on plan is conventional as actual numbering on posts is unreadable. One intermediate wooden post #3 is located within the road construction area and post #2 is located at 3m distance from the edge of proposed road.

Proposed road surface in this area will be elevated relative to ground level by 12.36m. Thus road surface will be located 1.35m higher than level of the upper conductor.

Needed measures.

It is necessary to replace route of existing 10 kV overhead line between posts #2-#4 by cable line that will be installed under the road in pipes (one working pipe, another – spare) and trench. The following works should be carried out:

- #2, #3 and #4 wooden posts with reinforced concrete supports should be dismounted together with AC-35 type conductors in the spans between posts #1-#4;
- reinforced concrete terminal post #4a (height 11m) with support should be installed instead of wooden post #4;
- reinforced concrete terminal post #2a (height 11m) with support should be installed at 24m distance from existing post #1;
- steel bars with insulator assemblies and ОПН-10 type over-voltage limiters should be installed on terminal posts #2a and #4a on both ends of cable section of power line (according to requirement of ПУЭ-2002, article 2.5.70);

- copper cable line with 3X70mm^2 cross section should be installed in trench and pipes under the proposed new road between terminal posts #2a and #4a. "Raychem" type coupling sleeves should be used on ends of cable section of the line.

2. Crossing #2 (KP 20+30 - 20+50)

Route of the new road is crossed by the existing 110kV double-circuit overhead power line "Sanavardo-1,2". Crossing takes place in spans between П110-4 type intermediate tower #7 and П110-6 type intermediate tower #8 (span length – 300.3m) and between П110-6 type intermediate tower #8 and У110-2+5 type angle tower #8 (span length – 263.5m). П110-6 type intermediate tower #8 is located within the area of road construction. Thus, it is needed to relocate it to new position outside the road route. This power line connects 110/10kV substations "Samtredia-1" and "Samtredia-2". Cross section of conductors is AC-150mm^2. Total length of overhead power line is 5.4 km.

Distance between ground surface and lower conductor of power line at intermediate tower #8 is 17.7m. Distance between conductors – 6m. Elevation of new road surface will be increased by 10.2m and distance between road surface and lower conductor will become 7.3m (i.e within requirement of norms ПУЭ-2002, Article 2.5.147, Table 2.5.32.

Current situation does not correspond to requirement of norms by following two conditions:

- at crossing point existing towers (#7 and #8) are intermediate towers and not the anchor-type towers (ПУЭ-2002, Article 2.5.16).
- Insulator assemblies are hanging-type and not the stretching-type insulator assemblies with separate connection to each circuit of the line (ПУЭ-2002, Article 2.5.96).

<u>Needed measures</u>

It is necessary to install anchor-type towers on both sides of span where 110kV overhead line crosses new road. Conductors on these towers should be installed on double-circuit insulator assemblies. Distances between towers and road edge must be equal to 35-45m (height of tower). In order to achieve these the following measures should be implemented:

- existing anchor-type angle tower #9 should be used on one side of the road and existing tower #8 on other side of the road should be replaced with elevated anchor-type double-

circuit tower #8a Y220-2+14 installed 50m closer to tower #9 regarding position of tower #8.

- existing intermediate tower #8 should be dismounted;
- new AC-150 conductors should be installed on stretching insulator assemblies in the spans between towers.

As length of span is 318m, the distance between transversal bars on tower #8a is taken equal to 6.5m (with account of oscillation of conductors). That's why Y220-2+14 anchor-type towers were recommended. Foundations of this tower should be made of F2-A type reinforced concrete foundations and P1-A type reinforced concrete bars (final selection should be made on the detailed design stage).

Distance from road surface to lower transversal bar of tower will be 24.5m. Distance from tower to road axis – 74.7m. Elevation of road surface is 29.1m and elevation of lower conductor is 38.64m (see drawing with longitudinal profile of road). Thus, distance between conductor and road surface will be 9.54m that is larger than normative requirement – 7m.

Connection of conductors to Y220-2+14 type tower #8a and Y110-2+5 type tower #9 at crossing of I category road should be made according to requirements of ПУЭ-2002, Article 2.5.96 – with use of double-circuit stretching insulator assemblies and separate fixing of each circuit to anchor-type towers.

Before start of dismounting of tower #8 it is necessary to install foundations for new tower #8a. As conductors in this spans are damaged at several places it is recommended to install new AC-150 type conductors.

3. Crossing #3 (KP 54+40 – 54+80)

Route of new road crosses the existing 0.4kV overhead power line installed on wooden posts with reinforced concrete supports. Numbering of posts is conventional. Two wooden posts #3 and #4 are located within the area of road construction. Proposed road will go over the bridge and the overpass – road surface elevation will be increased by 6.79m and distance to power line conductors will be only 1.74m.

Needed measures

Section of 0.4kV power line between posts #2 and #5 should be replaced with underground cable line installed in pipes and trenches under the proposed road. Two posts #3 and #4 should be dismounted.

Two reinforced concrete posts #3a and #4a (height 9m) should be installed on both sides of the proposed road at 10m distance from road edge (ПУЭ-2002, Article 2.5.147, table 2.5.32). Copper cable line (cross section 3x6mm^2) should be installed in trench and pipes (placed under road) between new posts #3a and #4a and connected to existing conductors by means of connection sleeves.

4. Crossing #4 (KP 61+00 – 66+00)

Road route crosses existing 10 kV overhead line on wooden posts with reinforced concrete supports. Numbering of posts is conventional as actual numbering on posts is unreadable. Four posts (#2 - #5) are located within the area of road construction.

Road surface will be elevated by 3.2m and distance from road surface to 10kV power line conductor will become 5.6m, that is less than permitted distance – 7m (ПУЭ-2002, Article 2.5.147, table 2.5.32). Crossing angle is 25 degrees, therefore distance of crossing is about 180m.

Needed measures

In order to reduce length of crossing distance it is necessary to change route of 10kV power line and make 90 degree crossing at #6 post. Section of 10 kV overhead line should be replaced with underground cable line installed in pipes laid under the new road (one pipe for current cable and one spare pipe for future use).

Existing #1 wooden post should be replaced with reinforced concrete corner post #1a (height 11m) and post #6 should be replaced with reinforced concrete terminal post #6a. New overhead power line section should be installed on posts #1a-#5a (conductor AC-35) in parallel to road route.

Steel bars with stretching insulator assemblies and ОПН-10 type over-voltage limiters should be installed on terminal posts #1a and #6a on both ends of cable section of power line (according to requirement of ПУЭ-2002, article 2.5.70).

Existing posts #1-#6 should be dismounted together with existing conductors AC-35.

Connection of 10kV copper cables with cross section 3x70mm^2 should be made with use of Raychem-type splice connection sleeves.

5. Crossing #5 (KP 65+60)

Route of new road crosses existing 10 kV overhead line on wooden posts with reinforced concrete supports. Numbering of posts is conventional as actual numbering on posts is unreadable. One intermediate post (#26) is located within the area of road construction.

Road surface will be elevated by 2.0m. At location of this crossing adjacent roads are located and construction of road junction is planned. crossing of roads and power line takes place at several places. existing 10kV line #22 and #23 are located within area of construction of road junction. At this section road also crosses cathodic protection cable (on reinforced concrete posts) of existing gas pipeline. Posts #25, #27, #11, #12, #13 are located within area od road junction construction and normative distances are violated.

Existing posts of 10kV power line and AC-35 conductors are outdated and damaged. It is recommended to replace them with new posts and conductors.

<u>Needed measures</u>

Section of existing 10kV overhead power line between posts #25-#27 should be replaced with cable line that will be installed in trenches and pipes placed under the road (one pipe for current cable and one spare pipe for future use).

Route of 10kV overhead power line on sections between posts #21-#25 and #27, #10-#14 should be replaced by new route. Existing posts and conductors on these sections should be dismounted.

New copper cable line (cross section 3x70mm^2) between posts #27a and #28a should be installed in trenches and pipes placed under the road. Connection of cables with existing conductors should be made with use of Raychem-type splice connection sleeves.

6. Crossing #6 (KP 65+60)

New road, its junctions and connected roads cross existing gas pipeline cathodic protection cable network that is fed from high-voltage packaged unit. Voltage of this network is 48V and nominal current is 63 A. Network uses VVG-1 type cable of 2x25mm^2 cross section. Part of this cable is installed partly in trench and part of it is on reinforced concrete posts on section between posts #1-#8. Existing posts #6, #7 and #8 are located within the area of road junction construction.

Needed measures

It is necessary to change the route of cathodic protection cable. Existing posts #6, #7 and #8 should be dismounted together with VVG-1 type cables in spans between these posts. On new route this cable (cross section 2x25mm^2) should be installed in corrugated plastic pipes (diameter 80mm) placed in trench. Connection of new and existing cables should be made with use of Raychem-type splice connection sleeves. Installation of VVG-1 cable (cross section 2x25 mm^2) in trench should be agreed with owner of the gas pipeline.

7. Crossing #7 (KP 106+90)

New road route crosses 10 kV overhead line on reinforced concrete posts. Numbering of posts on plan corresponds to actual numbering of posts (Number 15 is missing). Two intermediate post #14 and #16 are located within the area of road construction. Elevation of road surface will be increased by about 5.08m regarding the current ground level.

Needed measures

Section of existing 10kV overhead line between posts #13-#14-#16-#17 should be replaced with underground cable line installed in trenches and pipes placed under the road (one working pipe, another – spare). The following technical measures should be carried out:

- #14 and #16 reinforced concrete posts should be dismounted and AC-35 type conductors in spans between posts #13, #14, #16 and #17 should be dismounted too;

- reinforced concrete terminal post #14a (height 9m) should be installed at 30m distance from existing post #13;
- existing intermediate post #17 should be converted to terminal post #17a by installing reinforced concrete support (length 9m);
- posts #14a and #17a should be upgraded with metal transversal bars with stretching insulator assemblies and ОПН-10 type over-voltage limiters that should be connected to AC-35 conductors;
- on section between posts #14a and #17a new underground copper cable (cross section 3x70mm^2) should be installed in trench and pipes placed under the road. Connection of cables should be made with use of Raychem-type splice connection sleeves.

Scope of Construction-Installation Works

	Description	Unit	q-ty.	Notes
	Crossing #1 (KP 1+57 – 1+61) **10kV overhead lines**			
	Demolitions			
1.1	Dismounting of 10 kV line intermediate wooden posts with reinforced concrete supports	set	3	
1.2	Dismounting of AC-35 conductors from insulators (three phases)	m	410	
	Installation Works			
2.1	Digging of pit (∅40cm, depth 2.5m) for installation of reinforced concrete post of 10kV line	it/m^3	4/1.28	
2.2	Installation of reinforced concrete post (height 11m) of 10kV line in pit and backfilling of pit	it	4	
2.3	Digging of cable trench in ground (width 0.4m, depth 0.8m) and its backfilling after installation of pipes and cable	m/m^3	110/35	
2.4	Installation of ∅100 mm steel pipes (length 80 m) in trench	it/m	2/160	
2.5	Installation of ∅100mm steel pipes on post structures	it/m	2/4	
2.6	Installation of metal transversal bar with three insulators on 10kV line posts	set	2	
2.7	Installation of AC-35 conductors dismounted earlier on insulators	m	270	
2.8	Installation of 3X70 mm^2 copper cables in ∅100mm pipes	m	84	
2.9	Installation of 3X70 mm^2 copper cables in trench	m	30	
2.10	Installation of 3X70 mm^2 copper cables on structures of reinforced concrete posts with use of brackets	m	20	
2.11	Installation of 3-phase terminal coupling sleeves (manufacturer “Raychem”) and connection to AC-35 conductors	set	2	
2.12	Installation of metal transversal bar with three insulators and ОПН-10 type over-voltage limiters on 10kV line reinforced concrete posts	set	2	
2.13	Obtaining approval on new routes of high voltage line from the owner of line and switching of live feed	-	1	

	Crossing #2 (KP 20+80 – 20+50) 110kV Overhead line "Sanavardo-1,2"			
	1. Demolitions			
1.1	Dismounting of AC-150 conductor from insulators	m/t	1800/1.08	
1.2	Dismounting of 110kV double-circuit П110-6 type intermediate tower (with sets of insulators)	set/t	1/3.95	
1.3	Dismounting of C-50 lightning protection rope	m	600	
	2 Installation Works			
2.1	Digging of pit (size 10X10X4m) for foundations of 220 kV anchored-corner, elevated, galvanized steel towers and its backfilling after installation	it/m^3	1/490	
2.2	Installation of Ф2-А type reinforced concrete foundations and grounding circuits	it/t	4/12	
2.3	Installation of PA-1 type reinforced concrete bars	it/t	8/3.2	
2.4	Installation of Y220-2+14 type galvanized steel, anchored, elevated, double-circuit tower	set/t	1/24.7	
2.5	Installation of 110kV double-circuit tightening insulators	set/t	6/0.96	
2.6	Installation of 110kV single-circuit tightening insulators	set/t	6/0.66	
2.7	Installation of steel-aluminum AC-150 conductors	m/t	1800/1.08	
2.8	Installation of lightning protection steel rope C-50	m	600	
2.9	Obtaining approval on new routes of high voltage line from the owner of line and switching of live feed	-	1	
	Crossing #3 (KP 54+40 – 54+80) **0.4kV overhead line**			
	1. Dismounting Work			
1.1	Dismounting of 0.4 kV line intermediate wooden posts with reinforced concrete supports	set	2	
1.2	Dismounting of 3x4 mm^2 cables of overhead line	m	132	
	2. Installation Works			
2.1	Digging of pit (∅40cm, depth 2.5m) for installation of reinforced concrete post of 0.4 kV line	it/m^3	4/1.28	
2.2	Installation of reinforced concrete post of 0.4 kV line in pit and backfilling of pit	it	4	
2.3	Digging of cable trench in ground (width 0.4m, depth 0.8m) and its backfilling after installation of pipes and cable	m/m^3	90/29	
2.4	Installation of ∅100mm steel pipes on post structures	it/m	2/4	
2.5	Installation of ∅100 mm steel pipes in trench	it/m	1/90	

2.6	Installation of 3X6 mm^2 copper cables in ∅100mm pipes	m	74	
2.7	Installation of 3X6 mm^2 copper cables in trench	m	20	
2.8	Installation of 3X6 mm^2 copper cables on structures of reinforced concrete posts with use of brackets	m	20	
2.9	Installation of 3-phase terminal coupling sleeves (manufacturer "Raychem") and connection to 3x6 mm^2 cables	set	2	
2.10	Obtaining approval on new routes of high voltage line from the owner of line and switching of live feed	-	1	
	Crossing #4 (KP 61+00 – 66+00) **10kV overhead lines**			
	Dismounting Works			
1.1	Dismounting of 10 kV line intermediate wooden posts with reinforced concrete supports	set	6	
1.2	Dismounting of AC-35 conductors from insulators (three phases)	m	855	
	2.Installation Works			
2.1	Digging of pit (∅40cm, depth 2.5m) for installation of reinforced concrete post of 10kV line	it/m^3	9/2.28	
2.2	Installation of reinforced concrete post (height 11m) of 10kV line in pit and backfilling of pit	it	9	
2.3	Digging of cable trench in ground (width 0.4m, depth 0.8m) and its backfilling after installation of pipes and cable	m/m^3	130/42	
2.4	Installation of ∅100 mm steel pipes (length 80 m) in trench	it/m	2/160	
2.5	Installation of ∅100mm steel pipes on post structures	it/m	2/4	
2.6	Installation of metal transversal bar with three insulators on 10kV line posts	set	5	
2.7	Installation of AC-35 conductors dismounted earlier on insulators	m	750	
2.8	Installation of 3X70 mm^2 copper cables in ∅100mm pipes	m	84	
2.9	Installation of 3X70 mm^2 copper cables in trench	m	50	
2.10	Installation of 3X70 mm^2 copper cables on structures of reinforced concrete posts with use of brackets	m	20	
2.11	Installation of 3-phase terminal coupling sleeves (manufacturer "Raychem") and connection to AC-35 conductors	set	2	
2.12	Installation of metal transversal bar with three	set	2	

	insulators and ОПН-10 type over-voltage limiters on 10kV line reinforced concrete posts			
2.13	Obtaining approval on new routes of high voltage line from the owner of line and switching of live feed	-	1	
	<u>Crossing #5 (KP 65+60)</u> **<u>10kV overhead line</u>**			
	<u>Dismounting Works</u>			
1.1	Dismounting of 10 kV line intermediate wooden posts (height 11m) with reinforced concrete supports	set	11	
1.2	Dismounting of 10 kV line intermediate metal post (height 10m) with reinforced concrete supports	set	2	
1.2	Dismounting of AC-35 conductors from insulators (three phases)	m	2700	
	<u>2.Installation Works</u>			
2.1	Digging of pit (∅40cm, depth 2.5m) for installation of reinforced concrete post of 10kV line	it/m^3	20/6.4	
2.2	Installation of reinforced concrete post (height11m) of 10kV line in pit and backfilling of pit	it	20	
2.3	Digging of cable trench in ground (width 0.4m, depth 0.8m) and its backfilling after installation of pipes and cable	m/m^3	70/23	
2.4	Installation of ∅100 mm steel pipes (length 46 m) in trench	it/m	2/92	
2.5	Installation of ∅100mm steel pipes on post structures	it/m	2/4	
2.6	Installation of metal transversal bar with six insulators on 10kV line posts	set	4	
2.7	Installation of AC-35 conductors dismounted earlier on insulators	m	2500	
2.8	Installation of 3X70 mm^2 copper cables in ∅100mm pipes	m	50	
2.9	Installation of 3X70 mm^2 copper cables in trench	m	30	
2.10	Installation of 3X70 mm^2 copper cables on structures of reinforced concrete posts with use of brackets	m	30	
2.11	Installation of 3-phase terminal coupling sleeves (manufacturer “Raychem”) and connection to AC-35 conductors	set	2	
2.12	Installation of metal transversal bar with three insulators and ОПН-10 type over-voltage limiters on 10kV line reinforced concrete posts	set	2	
2.13	Obtaining approval on new routes of high voltage line from the owner of line and switching of live feed	-	1	

	Crossing #6 (KP 65+60) **0.4kV overhead line (Cathodic protection of pipeline)**			
	1. Demolitions			
1.1	Dismounting of 0.4 kV line intermediate reinforced concrete posts (height 11m)	it	3	
1.2	Dismounting of 0.4 kV VVG-1 type power cable 2x25 mm^2 from posts	m	80	
1.2	same, in corrugated pipes in ground	m	30	
	2.Installation Works			
2.1	Digging of trench (width 30cm, depth 1.0m) and backfilling after installation of pipes and cables	m/m^3	120/36	
2.2	Installation of ∅100 mm steel pipes (length 30 m) in trench	it/m	2/60	
2.3	Installation of ∅80 mm corrugated pipes in trench	it/m	1/90	
2.4	Installation of 2X25 mm^2 VVG-1 type cables in ∅100mm pipes	m	64	
2.5	Installation of 2X25 mm^2 VVG-1 type cables in ∅80mm corrugated pipes	m	90	
2.6	Installation of 2X25 mm^2 VVG-1 type cables on structures of reinforced concrete posts with use of brackets	m	30	
2.7	Installation of 3-phase terminal coupling sleeves (manufacturer "Raychem") and connection to 2x25 mm^2 VVG-1 type cables	set	2	
2.8	Obtaining approval on new routes of high voltage line from the owner of line and switching of live feed	-	1	
	Crossing #7 (KP 106+90) **10kV overhead line**			
	Dismounting Works			
1.1	Dismounting of 10 kV line intermediate reinforced concrete posts	set	2	
1.2	Dismounting of AC-35 conductors from insulators (three phases)	m	435	
	2.Installation Works			
2.1	Digging of pit (∅40cm, depth 2.5m) for installation of reinforced concrete post of 10kV line	it/m^3	4/1.28	
2.2	Installation of reinforced concrete post (height 11m) of 10kV line in pit and backfilling of pit	it	4	

2.3	Digging of cable trench in ground (width 0.4m, depth 0.8m) and its backfilling after installation of pipes and cable	m/m^3	110/35	
2.4	Installation of ∅100 mm steel pipes (length 75 m) in trench	it/m	2/150	
2.5	Installation of ∅100mm steel pipes on post structures	it/m	2/4	
2.6	Installation of metal transversal bar with three insulators on 10kV line posts	set	2	
2.7	Installation of AC-35 conductors dismounted earlier on insulators	m	245	
2.8	Installation of 3X70 mm^2 copper cables in ∅100mm pipes	m	80	
2.9	Installation of 3X70 mm^2 copper cables in trench	m	35	
2.10	Installation of 3X70 mm^2 copper cables on structures of reinforced concrete posts with use of brackets	m	20	
2.11	Installation of 3-phase terminal coupling sleeves (manufacturer “Raychem”) and connection to AC-35 conductors	set	2	
2.12	Installation of metal transversal bar with three insulators and ОПН-10 type over-voltage limiters on 10kV line reinforced concrete posts	set	2	
2.13	Obtaining approval on new routes of high voltage line from the owner of line and switching of live feed	-	1	