

Bidding Document for Procurement of Small Works National Competitive Bidding



Procurement of Rehabilitation of the Secondary road

Ruisi-Agara-Agara Bypass (Lot 1) km95 - km114 Section Road Lighting Network Installation

NCB No: EWHIP-4/CW/NCB-04

Project ID: P130413

Volume I (Part 2)

**Roads Department of the Ministry of Regional
Development and Infrastructure of Georgia**

Volume 2

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Section II - Bid Data Sheet (BDS)

A. Introduction	
ITB 1.1	<p>The number of the Invitation for Bids is: EWHIP-4/CW/NCB-04</p> <p>The Employer is: <i>Roads Department of the Ministry of Regional Development and Infrastructure of Georgia</i></p>
ITB 1.1	<p>The name of the bidding process is:</p> <p>Procurement of Ruisi-Agara-Agara Bypass (Lot 1) km95 - km114 Section Road Lighting Network Installation</p> <p>The identification number of the bidding process is: EWHIP-4/CW/NCB-04</p> <p>The number and identification of lots comprising this bidding process are: <i>N/A</i></p>
ITB 2.1	The Borrower is: <i>Georgia</i>
ITB 2.1	<p>The name of the Project is: Forth East-West Highway Improvement Project (EWHIP-4)</p> <p>The estimated cost of proposed works is GEL 5,323,230.00 including all taxes, duties and other governmental levies as elaborated under clause ITB - 14.7. However, it is the responsibility of the bidder to submit a bid price, which could be below or above the estimated cost, based on the current market prices and any other factors which may influence the pricing of the proposed works.</p>
ITB 2.1	Loan amount: <i>USD 93.75 million</i>
ITB 4.1	Maximum number of members in the JV shall be: 3
ITB 4.4	<p>A list of debarred firms and individuals is available at the Bank's external website:</p> <p>www.worldbank.org/debarr</p>
B. Bidding Documents	

ITB 7.1	<p>For clarification purposes only, the Employer's address is:</p> <p>Requests for clarification should be submitted through the Georgian E- Government Procurement System.</p> <p>Requests for clarification should be received by the Employer no later than: 14 days prior to the deadline for submission of bids.</p>
ITB 7.1	The Employer will promptly publish its response at the Georgian E- Government Procurement System.
ITB7.4	<p>A Pre-Bid meeting shall not take place.</p> <p>A site visit conducted by the Employer shall not be organized</p>
C. Preparation of Bids	
ITB 10.1	<p>The language of the bid is: English</p> <p>All correspondence exchange shall be in English.</p> <p>Language for translation of supporting documents and print literature is as given above.</p>
ITB 11.1 (b)	The following schedules shall be submitted with the bid: Priced Bill of Quantities
ITB 11.1 (h)	<p>The Bidder shall submit with its bid the following additional documents:</p> <p>Time schedule</p> <p>Work program</p> <p>Work methodology</p>
ITB 13.1	Alternative bids shall not be permitted .
ITB 13.2	Alternative times for completion shall not be permitted .
ITB 13.4	Alternative technical solutions shall be permitted for the following parts of the Works: N/A
ITB 14.5	The prices quoted by the Bidder shall not be subject to adjustment during the performance of the Contract.
ITB 15.1	The prices shall be quoted by the bidder in: Georgian Lari (GEL)

ITB 18.1	The bid validity period shall be: 90 days after the date specified for submission of bids.
ITB 18.3 (a)	The Contract price shall be adjusted by a factor: The inflation rate used for local currency shall be 28 days prior the date of Bids submission deadline. The source of inflation rate shall be: National Statistics Office of Georgia – www.geostat.ge
ITB 19.1	<p><i>The Bidder shall furnish a bid-securing declaration.</i></p> <p><i>Bidders are reminded that the format of the Bid-Securing Declaration should be in accordance with the form of Bid-Securing Declaration included in Section 4.</i></p> <p><i>Bid-Securing Declaration shall include the period of 1 (one) year when the Borrower may, declare the Bidder ineligible to be awarded a contract by the Employer.</i></p> <p><i>Bid-Securing Declaration shall be valid for 28 days beyond the validity of the Bid (i.e., 90 days + 28 days = 118 days).</i></p> <p><i>For bids submitted by a JV bidder shall carefully read ITB 19.8 as failure to comply with this ITB may be grounds for bid rejection.</i></p>
ITB 19.3 (d)	Other types of acceptable securities: <i>None</i>
ITB 19.9	If the Bidder incurs any of the actions prescribed in sub paragraphs(a)or (b)of this provision, the Borrower will declare the Bidder in eligible to be awarded contracts by the Employer for a period of 1 (one) year.
ITB20.1	In addition to the original of the bid, the number of copies is: <i>N/A</i>
ITB 20.2	<p>The written confirmation of authorization to sign on behalf of the Bidder shall consist of:</p> <p>(a) <i>Power of Attorney; and</i></p> <p>(b) <i>In the case of Bids submitted by an existing or intended JV an undertaking signed by all parties (i) stating that all parties shall be jointly and severally liable, and (ii) nominating a Representative who shall have the authority to conduct all business for and on behalf of any and all the parties of the JV during the bidding process and, in the event the JV is awarded the Contract, during contract execution along with statement showing the volume of works to be carried out by each member.</i></p>

ITB21.1	<p>Bidders <i>shall submit</i> their bids electronically through Georgian E- Government Procurement System.</p> <p>Government procurement procedures SHALL NOT apply for this procurement. Bid submission and bid opening will take place electronically using Georgian</p> <p>E-Government Procurement System with certain modifications. Major modifications to the Georgian E-Procurement System are:</p> <ul style="list-style-type: none"> - Functionality of the three round sofe-Reverse auction is removed. Rounds will not be applicable. - The estimated cost of the contract is disclosed in the E-Procurement system and bidders can submit a bid price, which could be below or above the estimated cost, however pricing the bid is the responsibility of the bidder, which shall be based on the current market prices and any other factors which may influence the pricing of the proposed works. <p>Please note that bidding is conducted under National Competitive Bidding (NCB)procedures as specified in the World Bank’s Guidelines: Procurement of Goods, Works and Non-Consulting Services under IBRD Loan sand IDA Credits&Grants by World Bank Borrowers, January2011, revised July2014 (“Procurement Guidelines”).</p>
ITB21.2 and 21.3	N/A
ITB22.1	Bidders shall follow the electronic bid submission procedures of Georgian E- Government Procurement System.
ITB22.1	Bidders <i>shall submit</i> their bids <i>electronically</i> through Georgian E- Government Procurement System

ITB25.1	<p>ITB Clause25.1 is modified to read the following:</p> <p>Bid opening will take place electronically using Georgian E-Government Procurement System with certain modifications. Major modifications to the Georgian E-Procurement System are:</p> <ul style="list-style-type: none"> - Functionality of the three round safe-Reverse auction is removed. Rounds will not be applicable. - The estimated cost of the contract is disclosed in the E-Procurement system and bidders can submit a bid price, which could be below or above the estimated cost, however pricing the bid is the responsibility of the bidder, which shall be based on the current market prices and any other factors, which may influence the pricing of the proposed works. <p>The Minutes of the Bid Opening will be uploaded in the E-Procurement System following the bid opening.</p>
ITB 25.3	<p>The Letter of Bid and Priced Bill of Quantities are to be initialed by representatives of the Employer–N/A</p>
E. Evaluation and Comparison of Bids	
ITB 34.3	<p>Contractor’s proposed subcontracting: Maximum percentage of subcontracting permitted is: 40% of the total contract amount</p> <p>b) Bidders planning to subcontract more than 10% of total volume of work shall specify, in the Bid Submission Form, the activity (ies) or parts of the works to be subcontracted along with complete details of the sub-contractors and their qualification and experience. The qualification and experience of the sub-contractors must meet the minimum criteria for the relevant work to be sub-contracted failing which such sub-contractors will not be permitted to participate.</p> <p>c) Sub-contractors’ qualification and experience will not be considered for evaluation of the Bidder. The Bidder on its own (without taking into account the qualification and experience of the sub-contractor) should meet the qualification criteria.</p>
F. Award of Contract	

ITB 43.1	<p>The Adjudicator proposed by the Employer is:</p> <p>GEORGE BEGIASHVILI (GEORGIAN)</p> <p>Partner</p> <p>Begiashvili & Co. Limited</p> <p>39 GAMSAKHURDIA AVE., SUITE 42,</p> <p>TBILISI, 0160, GEORGIA</p> <p>TELEPHONE: (995 32) 251 454; 251 455</p> <p>FACSIMILE: (995 32) 934 906</p> <p>www.gbcolaw.com</p> <p>The hourly fee for this proposed Adjudicator shall be 120 (ONE HUNDRED AND TWENTY UNITED STATES DOLLARS).</p> <p>The biographical data of the proposed Adjudicator is as follows:</p> <p>EDUCATION:</p> <p>September 1982 - June 1987</p> <p>Tbilisi State University (Tbilisi, Georgia)</p> <p>Faculty of Law</p> <p>B.Sc. in Law</p> <p>September 1987 – June 1988</p> <p>Moscow Lomonosov University (Moscow, Russian Federation).</p> <p>Law Department</p> <p>Ph.D. in Law</p> <p>WORK EXPERIENCE:</p> <p>Since October 1995</p> <p>Employer: Law Firm Begiashvili & Co. Limited (Tbilisi, Georgia)</p> <p>Position: Director / Partner</p> <p>May 1994 - July 1995</p> <p>Employer: Law Firm Nabarro Nathanson (London, UK)</p> <p>Position: Associate (Georgian consultant)</p> <p>November 1993 - April 1994</p> <p>Employer: International Trade Firm “AGIO” (Moscow, Russian Federation)</p> <p>Position: Legal Consultant.</p>
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Section III - Evaluation and Qualification Criteria

This section contains all the criteria that the Employer shall use to evaluate bids and qualify Bidders if the bidding was not preceded by a prequalification exercise and post-qualification is applied. In accordance with ITB 35 and ITB 37, no other methods, criteria and factors shall be used. The Bidder shall provide all the information requested in the forms included in Bidding Forms.

Wherever a Bidder is required to state a monetary amount, Bidders should indicate the national currency. If any amounts are in foreign currency equivalent national currency using the rate of exchange specified by the bidder will be determined as follows:

- For construction turnover or financial data required for each year - Exchange rate prevailing on the last day of the respective calendar year (in which the amounts for that year is to be converted) was originally established.
- Value of single contract - Exchange rate prevailing on the date of the contract.

1. Margin of Preference – NOT APPLICABLE

2. Evaluation

In addition to the criteria listed in ITB 35.2 (a) – (e) the following criteria shall apply:

2.1 Adequacy of Technical Proposal

Evaluation of the Bidder's Technical Proposal will include an assessment of the Bidder's technical capacity to mobilize key equipment and personnel for the contract consistent with its proposal regarding work methods, scheduling, and material sourcing in sufficient detail and fully in accordance with the requirements stipulated in Section VII (Works Requirements).

2.2 Multiple Contracts – Not Applicable

2.3 Alternative Completion Times – Not Applicable

2.4 Technical Alternatives – Not Applicable

2.5 Specialized Subcontractors – Not Applicable

2.6 Non-conformities, Errors, and Omissions:

Pursuant to ITB 30.3, the adjustment shall be made using the following methodology: Subject to provisions under ITB 14.2 if: i) an item is not listed in the priced Bill of Quantities i.e. the item is missing or the item is listed and priced but it is non-conforming to the requirements of the bidding document; or ii) a component under the scope of work or a condition in the bid is non-conforming to the requirements in the bidding document; and provided that the Bid is determined substantially responsive notwithstanding non-conformance under i) and ii) above, the average price of the item or component quoted by substantially responsive bidders will be added to the bid price and the equivalent total cost of the bid so determined will be used for price comparison. If the cost of the non-conforming component or condition in the bid cannot be determined from other substantially responsive bids, the Employer will decide the price to be added for this purpose and for comparison of bids based on his own knowledge or as obtained from other sources.”

2.7 Additional Qualification Criterion

Bidder shall demonstrate that it has the capacity to handle one or more contract of the proposed works, while executing any outstanding works the bidder has already committed with the Employer or any other agencies. The Bidder shall submit the outstanding works In the form CCC (Current Contract Commitments/Works in Progress) with the bid.

"The Bidder's capacity is calculated as follows:

$AT1 = AT2 - OW$ Where:

AT1 – The bidder's available annual cumulative amount of contract(s) that can be awarded to the bidder under the proposed contract(s)

AT2 - Average Annual Construction Turnover of the Bidder as submitted in FORM FIN 3.2

OW – Annual Value of Outstanding Work including contracts awarded but work not yet started.

Any bid found to indicate false or misleading representations in the forms, statements and attachments or any other related document submitted in proof of the qualification requirements will be rejected and will be treated as fraudulent practice in accordance with ITB 3.1

(This table will be used to calculate the bidder's capacity and SHALL NOT be filled in by the Bidder)

Outstanding Work as submitted by the Bidder				
Contract Price				
Balance Work (estimate)				
Remaining Contract period (months)				
Annual value of remaining Works				
Cumulative value of Balance Work (OW)				
Bidder's Turnover				
Average Annual Turnover (AT2)				
Bidders Annual Capacity (AT1)= AT 2 - OW				
Current Procurement (under Evaluation)				
Contract Name	A	B	C	D
Bid Price				
Duration in Months				
Annual Value				
Any combination of Contracts where the Cumulative is less than AT1 can be awarded				
Single Contract				
Multiple Contracts				

Notes:

“For contracts with intended completion period not exceeding 12 months, and/or for contracts with remaining intended completion period not exceeding 12 months, the sum of REMAINING Balance Works will be taken into account while determining Bidders’ Annual Capacity (AT1)”.

Similar methodology applies to calculating value of Current Contract Under Evaluation, where contracts with intended completion period not exceeding 12 month will be considered only by its value”.

“In case the Bidder is a JV, volume of works to be carried out by each member as per Joint Venture Agreement shall be proportional to Bidder’s Annual Capacity (AT1)”.

3. Qualification

Eligibility and Qualification Criteria			Compliance Requirements				Documentation
No	Subject	Requirement	Single Entity	Joint Venture (existing or intended)			Submission Requirements
				All Parties Combined	Each Member	One Member	
1. Eligibility							
1.1	Nationality	Nationality in accordance with ITB 4.3	Must meet requirement	Must meet requirement	Must meet requirement	N/A	Forms ELI – 1.1 and 1.2, with attachments
1.2	Conflict of Interest	No conflicts of interest in accordance with ITB 4.2	Must meet requirement	Must meet requirement	Must meet requirement	N/A	Letter of Bid
1.3	Bank Eligibility	Not having been declared ineligible by the Bank, as described in ITB 4.4, 4.5, 4.6 and 4.7					Letter of Bid
1.4	Government Owned Entity of the Borrower country	Meets conditions of ITB 4.5	Must meet requirement	Must meet requirement	Must meet requirement	N/A	Forms ELI – 1.1 and 1.2, with attachments
1.5	United Nations resolution or Borrower’s country law	Not having been excluded as a result of prohibition in the Borrower’s country laws or official regulations against commercial relations with the Bidder’s country, or by an act of compliance with UN Security Council resolution, both in accordance with ITB 4.7 and Section V.	Must meet requirement	Must meet requirement	Must meet requirement	N/A	Forms ELI – 1.1 and 1.2, with attachments
2. Historical Contract Non-Performance							

Eligibility and Qualification Criteria							
Eligibility and Qualification Criteria			Compliance Requirements				Documentation
No	Subject	Requirement	Single Entity	Joint Venture (existing or intended)			Submission Requirements
				All Parties Combined	Each Member	One Member	
2.1	History of Non-Performing Contracts	Non-performance of a contract ¹ did not occur as a result of contractor default since 1st January, 2011.	Must meet requirement ⁶	Must meet requirements	Must meet requirement ²	N/A	Form CON-2
2.2	Suspension Based on Execution of Bid Securing Declaration by the Employer or withdrawal of the Bid within Bid validity	Not under suspension based on execution of a Bid Securing Declaration pursuant to ITB 4.6 or withdrawal of the Bid pursuant ITB 19.9.	Must meet requirement	Must meet requirement	Must meet requirement	N/A	Bid Submission Form

¹Non performance, as decided by the Employer, shall include all contracts where (a) non performance was not challenged by the contractor, including through referral to the dispute resolution mechanism under the respective contract, and (b) contracts that were so challenged but fully settled against the contractor. Non performance shall not include contracts where Employers decision was overruled by the dispute resolution mechanism. Non performance must be based on all information on fully settled disputes or litigation, i.e. dispute or litigation that has been resolved in accordance with the dispute resolution mechanism under the respective contract and where all appeal instances available to the Bidder have been exhausted.

² This requirement also applies to contracts executed by the Bidder as JV member.

Eligibility and Qualification Criteria			Compliance Requirements				Documentation
No	Subject	Requirement	Single Entity	Joint Venture (existing or intended)			Submission Requirements
				All Parties Combined	Each Member	One Member	
2.3	Pending Litigation	Bidder's financial position and prospective long term profitability sound according to criteria established in 3.1 below and assuming that all pending litigation will be resolved against the Bidder	Must meet requirement	N/A	Must meet requirement	N/A	Form CON – 2

Eligibility and Qualification Criteria			Compliance Requirements				Documentation
No	Subject	Requirement	Single Entity	Joint Venture (existing or intended)			Submission Requirements
				All Parties Combined	Each Member	One Member	
2.4	Litigation History	No consistent history of court/arbitral award decisions against the Bidder ³ since 1st January, 2011	Must meet requirement	Must meet requirement	Must meet requirement	N/A	Form CON – 2

³ The Bidder shall provide accurate information on the letter of Bid about any litigation or arbitration resulting from contracts completed or ongoing under its execution over the last five years. A consistent history of court/arbitral awards against the Bidder or any member of a joint venture may result in disqualifying the Bidder.

Eligibility and Qualification Criteria			Compliance Requirements				Documentation
No	Subject	Requirement	Single Entity	Joint Venture (existing or intended)			Submission Requirements
				All Parties Combined	Each Member	One Member	
3. Financial Situation and Performance							
3.1	Financial Capabilities	(i) The Bidder shall demonstrate that it has access to, or has available, liquid assets, unencumbered real assets, lines of credit, and other financial means (independent of any contractual advance payment) sufficient to meet the construction cash flow requirements estimated as GEL 700,000 for the subject contract(s) net of the Bidders other commitments	Must meet requirement	Must meet Requirement	N/A	N/A	Form FIN – 3.1, with attachments
		(ii) The Bidders shall also demonstrate, to the satisfaction of the Employer, that it has adequate sources of finance to meet the cash flow requirements on works currently in progress and for future contract commitments.	Must meet requirement	Must meet requirement	N/A	N/A	
		(iii) The audited balance sheets or, if not required by the laws of the Bidder’s country, other financial statements acceptable to the Employer, the last 3 years (2013, 2014 and 2015) shall be submitted and must demonstrate the current soundness of the Bidder’s financial position and indicate its prospective long-term profitability.	Must meet requirement	N/A	Must meet requirement	N/A	
3.2	Average Annual Turnover	Minimum average annual turnover of GEL 2,500,000 calculated as total certified payments received for contracts in	Must meet requirement	Must meet requirement	Must meet 25% of the requirement	Must meet 40%of the requirement	Form FIN – 3.2

Eligibility and Qualification Criteria			Compliance Requirements				Documentation
No	Subject	Requirement	Single Entity	Joint Venture (existing or intended)			Submission Requirements
				All Parties Combined	Each Member	One Member	
		progress and/or completed within <i>the last 3 years (2013, 2014 and 2015), divided by 3 years.</i>					

Eligibility and Qualification Criteria			Compliance Requirements				Documentation
No	Subject	Requirement	Single Entity	Joint Venture (existing or intended)			Submission Requirements
				All Parties Combined	Each Member	One Member	
4. Experience							
4.1 (a)	General Construction Experience	Experience under construction contracts in the role of prime contractor, JV member, sub- contractor, or management contractor for at least the last <i>5 years, starting1st January 2011.</i>	Must meet requirement	N/A	Must meet requirement	N/A	Form EXP – 4.1
4.2 (a)	Specific Construction & Contract Management Experience	(i)A minimum number of similar ⁴ contracts specified below that have been satisfactorily and substantially ⁵ completed as a prime contractor, joint venture member ⁶ , management contractor or sub-contractor between 1st January 2009 and bid submission deadline: One (1) contract of minimum value GEL 1,500,000 or two (2) contracts minimum of total value GEL 1,500,000 of lightning	Must meet requirement	Must meet requirement ⁷	N/A	N/A	Form EXP 4.2(a)

⁴ The similarity shall be based on the physical size, complexity, methods/technology and/or other characteristics described in Section VII, Work's Requirements. Summation of number of small value contracts (less than the value specified under requirement) to meet the overall requirement will not be accepted.

⁵ Substantial completion shall be based on 80% or more works completed under the contract.

⁶ For contracts under which the Bidder participated as a joint venture member or sub-contractor, only the Bidder's share, by value, shall be considered to meet this requirement.

⁷ In the case of JV, the value of contracts completed by its members shall not be aggregated to determine whether the requirement of the minimum value of a single contract has been met. Instead, each contract performed by each member contributing to meeting the requirement shall satisfy the minimum value of a single contract as required for single entity. In determining whether the JV meets the requirement of total number of contracts, only the number of contracts completed by all members each of value equal or more than the minimum value required shall be aggregated.

Eligibility and Qualification Criteria			Compliance Requirements				Documentation
No	Subject	Requirement	Single Entity	Joint Venture (existing or intended)			Submission Requirements
				All Parties Combined	Each Member	One Member	
		roads, streets, public squares or buildings.					
4.2 (b)		For the above and any other contracts completed and under implementation as prime contractor, joint venture member, management contractor or sub-contractor ⁸ on or after the first day of the calendar year during the period stipulated in 4.2 (a) above, a minimum construction under implementation as prime contractor, joint venture member, management contractor or sub-contractor ⁹ on or after the first day of the calendar year during the period stipulated in 4.2 (a) above, a minimum construction experience in the following key activities successfully completed ¹⁰ :	Must meet requirements	Must meet requirements	N/A	N/A	Form EXP – 4.2 (b)

⁸ For contracts under which the Bidder participated as a joint venture member or sub-contractor, only the Bidder's share shall be counted to meet this requirement.

⁹ For contracts under which the Bidder participated as a joint venture member or sub-contractor, only the Bidder's share shall be counted to meet this requirement.

¹⁰ Volume, number or rate of production of any key activity can be demonstrated in one or more contracts combined if executed during same time period. The rate of production shall be the annual production rate for the key construction activity (or activities).

Eligibility and Qualification Criteria			Compliance Requirements				Documentation
No	Subject	Requirement	Single Entity	Joint Venture (existing or intended)			Submission Requirements
				All Parties Combined	Each Member	One Member	
		Road Lighting Network Installation works for 3 km. of road in one year.					

5. Personnel

The Bidder must demonstrate that it will have the personnel for the key positions that meet the following requirements:

No.	Position	Total Work Similar Experience (years)	In Similar Works Experience (years)
1	Project manager	10	5
2	Engineer electrician	15	5
3	Engineer electrician	10	5

The Bidder shall provide details of the proposed personnel and their experience records in the relevant Forms included in Section IV, Bidding Forms.

6. Equipment

The Bidder must demonstrate that it will have access to the key Contractor's equipment listed hereafter:

No.	Equipment Type and Characteristics	Minimum Number required
1	Crane	1
2	Excavator	1
3	Basket Crane	1

The Bidder shall provide further details of proposed items of equipment using the relevant Form in Section IV.

Cost estimation for asphalt material was calculated based on purchasing base from the nearest existing batch plant not producing at the construction site. However, the bidder shall consider which way is more efficient between purchasing and producing when they bid. Detail information for the nearest existing batching plant is attached in following page.

Section VII - Works Requirements

Specifications

Given design is prepared on the basis of the Georgian Road Department program. Design is prepared on the basis of the Design Task Description from 02.04.2015 that envisages preparation of design documents for installation of road lighting system and 10kV voltage feeding network for Ruisi-Agara-Agara By-pass road section of the I category highway Tbilisi-Senaki-Leselidze (Lpt-1, KP95-KP114). The following requirements are taken into account during the design process:

- Normative values on quality and number of lighting fixtures;
- Cost-efficiency of lighting systems, rational consumption of electric energy;
- Reliability of road lighting system elements;
- Safety of residents and service personnel;
- Simplicity of operation, maintenance and control of road lighting system.

Selected equipment and materials are corresponding to requirements of standards, technical voltage of network and ambient conditions.

During design of road lighting selection of lighting posts and lighting fixtures is made in agreement with Project Owner on architectural-planning peculiarities of the road section under design.

Design is prepared with account of requirements of the Rules for installation of Electric Equipment (H#3) for 10kV and 0.4kV voltage systems design norms and 0.4kV road lighting network design requirements – Chapter 6.3. Design is based on the following requirements of 11Y3 :

Article 6.3.2 During calculation of road lighting networks load coefficient is taken as 1.

Article 6.3.4 In road lighting network if protection device is serving more than 20 lighting fixtures per phase, then fuse or automatic switch should be installed at branch lines to lighting fixtures.

Article 6.3.12 Control system of road lighting allows for switching off the network within 3 minutes from one point.

Article 6.3.7 Feeding of road lighting system is arranged directly from transformer substations.

Article 6.3.14 Automatic control devices ensure switching on and off based on natural illumination level (with use of photo-elements).

The requirements of the following norms of the 11Y3-2012 were taken into account:

Article 6.3.15. As a rule, lighting network should have TN-C grounding system.

According to the Article 1.7.26 TN-C grounding system is a system where N and PE systems are joined in one PEN conductor along the whole length of the network.

Article 1.7.26. Feeding of 1kV voltage electric devices with use of TN system should be used for TN-C road lighting networks and electric energy distribution from transformer substations to power consuming devices.

Lighting Requirements

The following parameters are accepted as initial design parameter of the 0.4kV voltage road lighting network and 10kV feeding overhead power line network of the Ruisi-Agara-Agara By-pass section of the highway under design:

1. Category of object by lighting requirement – I category highway, lighting category – A², maximal intensity of two-way traffic (throughput) 7000-9000 per hour. Average brightness of road surface – 0.8 cd/m², average horizontal luminance $E_{av}=20$ Lux. Luminance distribution $E_{min}/E_{av}=U_0=0.35$
(СНП 23-05-95; СанПиН 2.2.1/2.1.1.1278-03; EN 13201, 2003; И52.13330.2011);
2. For highway road covers irrelevant to road traffic intensity the average brightness is accepted as 0.8 cd/m²;
3. Average brightness or average luminosity of road surface for road junctions on two or more levels should not be less than 0.8 cd/m² or 10 Lux;
4. Minimal brightness ratio to average value should not be less than 0.35;
5. Ratio of minimal brightness to maximal one within the road lines should not be less than 0.6;
6. In case of reduction of traffic intensity down to 1/3-1/5 of maximal value the permissible illumination reduction by means of lighting regulator is 30%-50%;
7. Blinding parameter for lighting devices should not exceed 150;
8. For I category highway the horizontal illumination according to IO!" 352766-2007 should not be less than:
Maximal $E_{max}30$ Lux; Average $E_{av}=15$ Lux (Table 8), for road junctions – $E_{av}=10$ Lux; $E_{min}/E_{av}U_0>0.25$
9. Illumination homogeneity coefficient – $E_{max}/E_{av}\leq 3$
10. Switching of road lighting devices on is carried out at twilight in the evening when natural illumination is less than 20 Lux and switching off – at dawn in the morning when natural illumination level is more than 19 Lux.

Illumination norms in Georgia are not introduced. Different countries have different norms. In most European countries two norms are enforced – internal norm of country and European standard norms. Often these norms differ from each other. Obtaining required illumination levels is achieved by selection of lighting fixture types, power capacities of lighting devices, height of lighting posts, corbel inclination angles.

Design takes into account the following normative requirements:

- for I category highway, class A2 (7000-9000 vehicles/hour):
 - o average illumination $E_{av}\geq 20$ Lux

- distribution of illumination $U0E_{min}/E_{av} \geq 0.35$
- 7-8m wide road junctions (II category), class B2 (1500-3000 vehicles/hour)
 - average illumination $E_{av} \geq 10$ Lux
 - distribution of illumination $U0E_{min}/E_{av} \geq 0.25$

Design lighting parameters were determined by use of software based on Dialux method.

Calculation of lighting parameters was carried out from three options of road – road width – 10m (for I category highway), road with 8 m and road width 6m (for II and III category roads, B2 class junctions)

With account of architectural-planning peculiarities of road the following solutions were accepted by design:

- height of lighting fixtures for all roads is taken the same – 11m;
- distance between lighting posts for all roads is taken the same – 40m;
- types of lighting posts and lighting fixtures are taken the same for all roads;
- for I category road the power capacity of lighting fixture was selected in such a value that provides average luminosity $E_{av} \geq 20$ Lux, with distribution of illumination $U_0 \geq 0.35$.
- for II and III category roads the lighting fixtures were selected with power that provides average luminosity $E_{av} \geq 10$ Lux, and distribution of illumination $U_0 \geq 0.25$

Results of computer-based calculation by Dialux method software are presented in separate report. In case of

replacement of selected lighting fixtures with other ones by Project Owner the results of lighting calculations

should be adjusted accordingly. Results of calculations are the following:

For I category road:

$E_{av}=20$ Lux; $E_{max}=32$ Lux; $E_{min}=6.57$ Lux, $U_0=0.36$

For II and III category road:

$E_{av}=10$ Lux; $E_{max}=17$ Lux; $E_{min}=3.10$ Lux, $U_0=0.297$

$E_{av}=11$ Lux; $E_{max}=17$ Lux; $E_{min}=3$ Lux, $U_0=0.285$

Technical parameters of lighting fixtures are the following:

Power load – 105W; 150W; 160

Frequency – 50-60Hz

Power coefficient - >0.95 ; >0.95

Efficiency of power source - $>0.90\%$; $>0.90\%$

Efficiency of LED lighting bulb - $>0.90\%$; $>0.90\%$

Luminosity of LED lighting bulb – 13300 lm; 20500 lm; >14400 lm

Corresponding color temperature – 2700-10.000K

CRI - >75 ; 75

Height of lighting posts - $\leq 12m$; $\leq 14m$

Average illumination >25 Lux; >25 Lux

Ambient temperature - $-40^{\circ}C$ $50^{\circ}C$

Ambient humidity 10%-90%; 10%-90%

Protection degree (for lighting bulb) – IP65, IP66

Operation time – 50000 hours

Power Supply. 10kV Feeding Network

Power source for road lighting system is existing network of JSC “Energo Pro Georgia”. Commercial metering of consumed electric energy should be arranged according to the Technical Conditions.

According to the Technical Conditions of the JSC “Energo Pro Georgia” from 02.04.2015 the power source of road lighting system of Ruisi-Agara-Agara By-pass section of road (Lot-1, KP95-KP114) will be provided from three points of 10kV network of distribution company:

1. 10kV overhead transmission line “Ruisi” coming from substation “Kareli-Tseva”
2. 10kV overhead transmission line “Bebnisi” coming from substation “Breti”
3. 10kV overhead transmission line “Agara” coming from substation “35/10kV - Agara”

Given design consists of four parts:

- Installation of 10kV voltage branch lines and commercial metering units
- Selection of power capacities and location of 10/0.4kV voltage transformer substations
- Working out of 10kV voltage feeding cable network
- Working out of 0.4/0.23kV voltage road lighting network

Construction of road section is completed – road cover is completed, protective barriers on demarcation strip between traffic lines is installed and space between barriers is filled with soil. This condition of road determined technical solutions for road lighting network installation.

10kV voltage branch lines and electric energy metering units will be arranged according to the Technical Conditions of the JSC “Energo Pro Georgia”. On branch lines it is envisaged to install disconnector and OIHH-10 type overvoltage limiters and provide power to electric energy meter units by 10kV cable lines.

Branch lines and metering units should be installed near the 10kV feeding network.

Number of 10/0.4kV voltage transformer substations and their power capacities were selected on the basis of expected loads and location of power source. Factory made packaged transformer substations should be used. Parameters of these substations are determined by the requirements of the Technical Conditions. Design envisages installation of grounding circuit and fencing around the substations. Resistance of grounding circuit should not exceed 4 Ohms and is calculated for the following soil parameters $r=100 \text{ Ohm/m}$.

Installation of 10kV voltage feeding line by cable line is determined by the following conditions:

- architectural-planning peculiarities

- installation of 0.4kV lighting network cables in trenches in demarcation strip between traffic lines

- 10kV voltage feeding cables will be installed in the same trenches together with 0.4kV voltage

- lighting network cables at 0.8m depth

- 10kV voltage feeding cable route saves area of land along whole length (approximately 20kmx10m

- equals to 200 000 m²)

- 10kV and 0.4kV voltage cables in trench will be protected by laying of warning tape along whole

- length of cable line route

0.4/0.23kV voltage road lighting network will be installed as cable line in trench in demarcation strip between traffic lines (between protective barriers) and in corrugated pipes fixed on structures of bridges and overpasses.

Calculation of cross sections of road lighting network conductors is carried out with account permissible voltage loss values (up to 5% from substation to last lighting fixture) and checking of phase-zero short circuit at end of line.

10m high lighting posts are selected by design calculations from three options – 10m, 11, and 12m.

For lighting of highway design envisages use of metal posts with two lighting fixtures and two posts with one lighting fixture are envisaged for bridges.

Location of the Metering Units on the Territory

Cabinet of the 10kV voltage electric energy commercial metering unit should be installed on concrete belt foundation with socle that must be elevated from the ground surface by 0.6m. Space between socle walls should be filled with sand-gravel mix and top 0.15m layer should be filled with gravel. Outside the socle the sand-gravel cover should be arranged with top layer of fertile soil on its slopes.

High voltage cables entering and coming out from metering unit cabinet should be installed underground – in space between foundation walls and socle.

Cabinet housing should be connected to the grounding circuits of nearest 10/0.4kV transformer substations (#2, #6 and #10) by means of 40x4mm steel strips installed in cable trenches.

About 9m² area (3.0mx3.0m) is needed for installation of one metering unit. Distance from metering unit to appropriate transformer substation should be agreed with the JSC “Energo Pro Georgia”.

Location of 10/0.4kV – 25kVA Transformer Substations on Territory

10/0.4kV voltage transformer substations are selected according to loads of 0.4kV voltage lighting network.

Container with equipment of the transformer substation should be installed on concrete belt foundation with socle that must be elevated from ground surface by 0.6m. Space between socle walls should be filled with sand-gravel mix and top 0.15m layer should be filled with gravel. Outside the socle the sand-gravel cover should be arranged with top layer of fertile soil on its slopes. (Alternative technical solution is also possible according to recommendations of manufacturer of packaged transformer substations).

High voltage 10kV cables entering and coming out from transformer substation should be installed underground – in space between foundation walls and socle.

Housing of the transformer substation should be connected to the grounding circuit installed along the perimeter of slopes of land plot of the substation.

About 36m² area (6.0mx6.0m) is needed for installation of one metering unit. Transformer substation's land plot should be fenced with 2m high wire mesh fence. Sections of fence made of 40x40x4mm steel angle bars should be fixed on $\varnothing 57$ mm steel pipe posts installed in ground at 1.2m depth. (Alternative technical solution is also possible).

Design documents contain coordinates for location of transformer substations. Prior to installation location of transformer substations should be checked on site.

Packaged Transformer Substations

One-line diagrams of the packaged transformer substations (10/0.4kV) are determined by the general power supply scheme. Source of power for packaged transformer substations will be branch lines from the metering units (with commercial meters on 10kV side) connected to the existing 10kV network of the JSC “Energo Pro Georgia”.

According to power supply scheme one of new packaged transformer substations will be installed near the metering unit and will be connected to distribution network. 10/0.4kV packaged transformer

substations will have two-ray scheme (input-output) and will be connected to next 10/0.4kV packaged transformer substation.

For Ruisi-Agara-Agara By-pass section road lighting 12 packaged transformer substations were selected. JSC

“Energo Pro Georgia” allocated three feeding points for these transformer substations:

- outgoing 10kV overhead line “Ruisi” from substation “KareliOTseva”,
- outgoing 10kV overhead line “Bebnisi” from substation “Breti”,
- outgoing 10kV overhead line “Agara” from substation “35/10kV Agara”.

Thus, feeding of 10/0.4kV packaged transformer substations included into design of road lighting network

will be arranged by three main lines. Each main line will feed four transformer substations.

Packaged transformer substations should comply with the following requirements:

- Temperature range -45°C - $+45^{\circ}\text{C}$, climatic rating – Y1;
- External insulation – grade II-III;
- By operation requirements for included equipment – operation on elevations up to 1000m above sea level;
- Wind and freezing resistance – I-IV region;
- Ambient conditions – explosion-free and fire-safe environment, without electric conducting dust, no chemical admixtures (Type II atmosphere);
- No vibration and shocks.

Packaged transformer substation should have cable incoming and outgoing lines on 10kV side and cable outgoing lines on 0.4kV side.

Schemes of substations are shown on main power supply schemes.

Power capacities of transformers were selected on the basis of expected loads from road lighting network. Required power capacities of 10/0.4kV packaged transformer substations are between 11.7kW and 17.3kW.

When selecting the power capacities of transformers the minimal permissible losses of electric energy were taken into account – load coefficients of transformers equal to 0.65-0.85.

Main parameters of selected transformer substations are the following:

- Capacity of hermetic power transformer – 25kVA, Nominal voltage – 10kV, Nominal current –

- 1.45A, Maximal operational voltage – 12 kV;

- On 0.4 kV side – Nominal voltage – 0.4kV, Nominal current – 41.7A;

- Nominal current of 10kV fuse – 5A;

- Level of insulation contamination – II, III;

- Resistance of insulation of substation circuits – 1000 Ohm;

- Noise level – 60 dB;

- Connection scheme of transformer coils and their group - D/X₀ - II;

- Insulation level – Normal;

- Housing protection degree – IP65;

- Relative air humidity – 80% at 25⁰C temperature.

Structural properties of the packaged transformer substation:

- Type – “Kiosk”- or “City”-type, in metal frame;

- Three compartments – 10kV (high) voltage equipment (HVE), power transformer and 0.4kV (low) voltage equipment (LVE).

10/0.4kV packaged transformer substation should have the following protections:

- Atmospheric and commutation over-voltage;

- Short circuit between phases;

- Overloading and short circuits between phases on 0.4kV lines;

- Short circuits on lighting lines.

The following blocking should be included:

- Blocking between main and grounding blades of load switch;

- Blocking between 0.4kV input disconnecter and automatic switch;

- Blocking between HVE compartment door and grounding blades of load switch. In case of open

- position of grounding blades opening of door should be impossible.

- Other types of blockings depending on the substation structural arrangement.

Packaged transformer substations should be installed on flat, compacted ground or special foundations. In case of installation on ground it is recommended to make a gravel bed.

Packaged transformer substation's 10kV distribution equipment should contain:

- On outgoing cable lines – load switch with main and grounding blades, OIИ-10 type overvoltage limiters;
- In power transformer cubicle – load switches with main and grounding blades, fuse.

Packaged transformer substation's 0.4kV distribution equipment should include:

- On incoming line – disconnecter and automatic switch;
- On outgoing lines – automatic switches and lighting control equipment;
- Current metering Amper-meters and back-up meter of consumed electric energy – electronic one-way three-phase electric meter with the following parameters: UN=220/380V, IN=5(10)A, precision class – no less than 1.0; counting mechanism – no less than 5+1 digits. Electric meter should be included into the Register of Measuring Devices Accepted in Georgia and should have seals and approval certificate of the Georgian National Agency for Standards, Technical Regulations and Metrology.

Housing of packaged transformer substation is the united welded structure top part of which has jalousies for ventilation of transformers.

For outgoing 0.4kV cables there should be holes covered with rubber

plates. Substation weight load on the ground should not exceed

0.5kg/cm².

Packaged transformer substation should have grounding circuit. Resistance of grounding circuit should correspond to requirements of Article 1.7 of the Rules of Installation of Electric Equipment (PIYƏ) and not exceed 4 Ohms for substations with 0.4kV outgoing line cables. Specific resistance of soil is not exceeding 100 Ohm/m.

Calculation of Grounding Circuit Resistance for 10/0.4kV Packaged Transformer Substation

Calculation of grounding circuit resistance for packaged substation is carried out for two cases – ground specific resistance $r=50$ Ohm/m and $r=100$ Ohm/m. According to requirements of the Article 1.7.62 of the Rules for Installation of Electric Equipment (PIYƏ) resistance of grounding circuit should not exceed 4 Ohms. Dimensions of the grounding circuit are shown on drawing.

Calculation of grounding resistance

Specific resistance of ground for wetland soils and dark soils is $r=50$ Ohm/m. Resistance of one vertical electrode (steel angle bar 40x40x4 mm, length 2m) is equal to:

$$R_{ver} = \frac{0.366\rho}{l} \left(\lg \frac{2l}{0.9b} + \frac{1}{2} \lg \frac{4t+l}{4t-l} \right) = 19 \text{ ohm}$$

Resistance on n electrodes is the following

$$R_{n.ver} = \frac{R_{ver}}{n\eta_{ver}} = \frac{19}{12 \cdot 0.5} = 3.2 \text{ ohm}$$

where $n=12$ is number of electrodes and for $l/l_2=1$, $\eta_{ver}=0.5$ (Table 6-

9). Resistance of horizontal electrode (steel strip 40x4 mm, length 24m) is

equal to:

$$R_{hor} = \frac{0.366\rho}{l} \lg \frac{2l^2}{b \cdot t} = \frac{0.366\rho}{24} \lg \frac{2 \cdot 24^2}{0.04 \cdot 0.7} = 3.13 \text{ ohm}$$

Resistance of steel strip with account of screening by other electrodes is:

$$R_{n.hor} = \frac{R_{hor}}{\eta_{hor}} = \frac{3.13}{0.6} = 5.21 \text{ ohm}$$

where $\eta_{hor} = 0.6$ (for $n=12$; $l/l_2=1$) (Table 6-

10). Total resistance of grounding circuit is the

following:

$$R_{gr} = \frac{R_{ver} \cdot R_{hor}}{R_{ver} + R_{hor}} = \frac{3.2 \cdot 5.21}{3.2 + 5.21} = \frac{16.67}{8.41} = 1.95 \text{ ohm} < 4 \text{ ohm}$$

that corresponds to requirements of norms.

Now consider case of specific resistance of soil $r=100$ Ohm x m.

Resistance of one vertical electrode (steel angle bar 40x40x4 mm, length 2m) is equal to:

$$R_{ver} = \frac{0.366\rho}{l} \left(\lg \frac{2l}{0.9b} + \frac{1}{2} \lg \frac{4t+l}{4t-l} \right) = 38 \text{ ohm}$$

Resistance on n electrodes is the following:

$$R_{nver} = \frac{R_{ver}}{n\eta_{ver}} = \frac{38}{12 \cdot 0.5} = 6.4 \text{ ohm}$$

where n=12 is number of electrodes and for $l/l_2=1$, $\eta_{ver}=0.5$ (Table 6-

9). Resistance of horizontal electrode (steel strip 40x4 mm, length 24m) is

equal to:

$$R_{hor} = \frac{0.366\rho}{l} \lg \frac{2l^2}{b \cdot t} = \frac{0.366 \cdot 100}{24} \lg \frac{2 \cdot 24^2}{0.04 \cdot 0.7} = 6.3 \text{ ohm}$$

Resistance of steel strip with account of screening by other electrodes is:

$$R_{nhor} = \frac{R_{hor}}{\eta_{hor}} = \frac{6.3}{0.6} = 10.5 \text{ ohm}$$

where $\eta_{hor} = 0.6$ (for n=12; $l/l_2=1$) (Table 6-

10). Total resistance of grounding circuit is the

following:

$$R_{gr} = \frac{R_{ver} \cdot R_{hor}}{R_{ver} + R_{hor}} = \frac{6.4 \cdot 10.5}{6.4 + 10.5} = \frac{67.2}{16.9} = 3.9 \text{ ohm} < 4 \text{ ohm}$$

that corresponds to requirements of norms.

In 10/0.4kV voltage 25 kVA power capacity packaged transformer substation the neutral of transformer is insulated on 10kV voltage side and grounded on 0.4kV voltage side. Due to varying electric resistance of soil the length of vertical electrodes is selected equal to [lv.gr.](#)=2m, and distance between them is also equal to 2m. Recommended ratio between these values ($l/l_2=1$) is also kept as in calculation. Required resistance of grounding circuit $R_{gr} < 4 \text{ Ohm}$ is observed (Articles 1.7.57-1.7.59 and 1.7.62, 17.36, Rules of Installation of Electric Equipment).

Selection of 10kV Cables

Transformer substations will be loaded by electric power load of lighting fixtures. Power rating of selected lighting fixture lamps is 153W (for I category roads) and 105W (for II and III category roads). Appropriate design power load from road lighting is equal to 165W.

From one substation maximum three groups of lighting fixtures will be fed (e.g. for substation #5):

- Group #1 – 24 fixtures: design load equals to 7.2 kW.
- Group #2 – 21 fixtures: design load equals to 6.0 kW.
- Group #3 - 16 fixtures: design load equals to 1.68 kW.
- Group #4 - 21 fixtures: design load equals to 2.21 kW

Total load of transformer substation is equal to:

$$P_{des.} = 7.2 + 6.0 + 1.68 + 2.21 = 17.3 \text{ kW}$$

that corresponds to value of total load (with $\cos\phi=0.9$)

$$S_{des.} = P_{des.}/\cos\phi = 17.3/0.9 = 18.2 \text{ kVA}$$

Selected 10/0.4kV power transformers have power rating 25kVA and their load coefficient is equal to:

$$K_{load} = S_{load}/ S_{des.} = 18.2 / 25 = 0.73$$

1. Selection of cross section of transformer substation feeding cable is based on cable overheating condition. According to transformer capacity design current at 10kV voltage is equal to:

$$I_{10kV \text{ nom.}} \quad \text{A}$$

In case of overloading

$$I_{10kV \text{ nom.}} = 1.3 \frac{S_{des.}}{\sqrt{3} U} = 1.3 \cdot \frac{18.2}{\sqrt{3} \cdot 10} = 1.45 \text{ A}$$

Calculated design current of transformer at 0.4kV voltage is equal to:

$$I_{0.4kV \text{ nom.}} \quad \text{A}$$

In case of overloading

$$I_{0.4kV \text{ nom.}} = 1.3 I_{0.4kV \text{ nom.}} = 1.3 \cdot 36.2 = 46.96 \text{ A.}$$

Based on cable overheating condition for 10kV cables the selected minimal cross section is $3 \times 16 \text{ mm}^2$, for which long period permissible current is 60A (for installation in air) and 75A (for installation in ground).

Total calculated power capacity of four 10/0.4kV transformer substations connected to each other is:

$$\Sigma P = P_1 + P_2 + P_3 + P_4 = 11.7 + 12.6 + 11.7 + 12.6 \gg 59.2 \text{ kW}$$

Total load is equal to:

$$\Sigma S = \Sigma P / 0.93 \approx 62.3 \text{ kVA}$$

Calculated current is equal to:

$$I = \frac{\Sigma S}{\sqrt{3} U} = \frac{62.3}{1.73 \cdot 10} = 3.7 \text{ A}$$

Total power capacity of transformers is equal to:

$$\Sigma \text{ Str.} = \frac{\Sigma S}{0.75} = \frac{62.3}{0.75} = 83 \text{ kVA}$$

With account of overloading possibility the total power capacity is:

$$\Sigma S_{\text{max.}} = 1.3 \cdot \Sigma \text{ Str.} = 1.3 \times 100 = 130 \text{ kVA}$$

Maximal current in line is:

$$I_{\text{max.}} \quad \text{A}$$

2. Selection of cable cross section on basis of current density gives small cross section that is unacceptable for 10kV voltage. Selected minimal cross section for 10kV voltage cables is $3 \times 16 \text{ mm}^2$.

3. Selection of 10kV cable cross sections on basis of voltage losses is determined by equation:

$$\Delta U \% = \frac{R \cos \varphi + X \sin \varphi}{U_{\text{nom}} \cdot \cos \varphi} P_m \cdot l_m$$

when network has the same $\cos\phi$, the same material cables are used and they have same cross section.

For copper cables results of calculations are given in Table below for different cross sections for #1 - #4 transformer substations:

##	Cross section, mm ²	Rcos ϕ + Xsin ϕ	moment ΣP_{mlm} kW.km	Voltage lost, %	Selected cross section	Transf. power moment ΣP_{tmlm}	Voltage loss, %	Selected cross section	
1	3X25	0.734	60.41	0.77%	distribution network 3X25	125.75	1.6%	-	
2	3X35	0.542	60.41	0.57	distribution network 3X35	125.75	1.18%	distribution network 3X35	
3	3X50	0.398	60.41	0.41%	-	125.75	0.85%	distribution network 3X50	

For transformer substations #5 - #8:

##	Cross section, mm ²	Rcos ϕ + Xsin ϕ	moment ΣP_{mlm} kW.km	Voltage lost, %	Selected cross section	Transf. power moment ΣP_{tmlm}	Voltage loss, %	Selected cross section	
1	3X25	0.734	70.81	0.9%	distribution network 3X25	115	1.46%	-	
2	3X35	0.542	70.81	0.67%	distribution network 3X35	115	1.16%	distribution network 3X35	
3	3X50	0.398	70.81	0.47%	-	115	0.77%	distribution network 3X50	

For transformer substations #9 - #12:

##	Cross section, mm ²	Rcos ϕ + Xsin ϕ	moment ΣP_{mlm} kW.km	Voltage lost, %	Selected cross section	Transf. power moment ΣP_{tmlm}	Voltage loss, %	Selected cross section	
1	3X25	0.734	71.27	0.91%	distribution network 3X25	137.75	1.75%	-	

2	3X35	0.542	71.27	0.67%	distribution network 3X35	137.75	1.3%	distribution network 3X35	
3	3X50	0.398	71.27	0.48%	-	137.75	0.93%	distribution network 3X50	

Based on power capacities of transformers from voltage drop condition the following cross sections were selected:

- feeding cable cross section – 3x50 mm²
- distribution network cable cross section – 3x35 mm²

At the ends of cable lines it is possible to reduce cable cross section down to 3x35 mm².

4. Selection of 10kV cables on the basis of condition on thermal strength against short circuit current. According to data obtained from the JSC “Energo Pro Georgia” the parameters of feeding source:

On 10kV busses of substation “Kareli-Tseva” the short circuit power capacity is _____ kVA, short circuit current is _____ kA.

On 10kV busses of substation “Breti” the short circuit power capacity is _____ kVA, short circuit current is _____ kA.

On 10kV busses of substation “34/10 Agara” the short circuit power capacity is _____ kVA, short circuit current is _____ kA.

Based on these data the minimal cross section of copper cables with account of thermal strength again short

circuit currents was selected:

- for feeding line from substation “Kareli-Tseva” – 3x50mm², (substations #2);
- for feeding line from substation “Breti” – 3x50 mm², (substations #6).
- for feeding line from substation “35/10 Agara” – 3x50 mm², (substations #10).

Finally, the following cross sections of cables were selected (on the basis of 4 conditions):

- for 10kV cables from JSC “Energo Pro Georgia” Metering Units to 10/0.4kV transformer substations – 3x50mm²;
- for cables between substations of the road lighting network – 3x35mm².

BBГ-10, BPF-10, NYY-10 type or similar copper cables are recommended with external diameters: BBГ-10 3X50mm² - 47.61mm, BBГ-10 3X35mm² – 44.82mm

Installation of 10kV cables

Route of 10kV cables will be the same as route of 0.4kV road lighting cable lines – in trench in ground in demarcation strip, between protective barriers.

Installation of 10kV cable lines instead of 10kV overhead line along the road is determined by the following reasons:

- purpose of 10kV line is only feeding of road lighting network;
- road lighting network will be installed in trench, pipes installed in ground and bridge (overpass) structures and its possible to install 10kV voltage lines in parallel to them with observing the all required rules;
- no additional land strip is occupied for overhead line and with account of cost of land this solution is cost effective.

10/0.4kV transformer substations will be located on the side of the road at 10-15m distance from the road edge. Their exact location should be checked on site.

10kV cables from 10/0.4kV substations should be placed in trench (together with 0.4kV voltage cables) at 0.8m depth according to requirements of Article 2.3 of the Rules of Installation of Electric Equipment. In order to protect 10kV cables from damage warning tape JIC-150 and JIC-300 should be placed over the cable along whole route of the cable lines. On bridges and overpasses 10kV cables should be placed in polyethylene pipes and fixed to bridge and overpass structures by special brackets.

Entering and coming out of 10kV voltage cables to/from 10/0.4kV transformer substations should be made with use of corrugated PVC pipes.

Installation of road lighting posts

Design of road lighting is made for roads with various width and intensity of traffic:

- I category road (main highway) with 11.5m wide roads in both directions and demarcation strip between them;

- bridges and overpasses on main highway 11.5m wide roads;
- junctions and branch roads (II and III category roads) with 7-8m wide roads;

In order to provide needed illumination of main highway the lighting posts will be installed in demarcation strip that is 2.85m wide. Distance between the lighting posts should be 40m. Height of lighting posts (from flange to lighting post should be 10m. Flanges should be installed on anchored foundations by means of nuts. Foundations for lighting posts should be installed in demarcation strip between road barriers. Top of the foundation should be elevated above road barriers by 100mm.

Two-arm lighting posts with two lighting fixtures will be used for I category road (main highway). Foundations of lighting posts can be factory made or cast in concrete on site.

For bridges on main highway the same type lighting posts will be used but with one-arm corbel and one lighting fixture.

For II and III category roads the same type lighting posts with one lighting fixtures will be used, but in the case power rating of lighting bulbs will be 105-120W. These lighting posts will be installed on reinforced concrete piles. After installation of pile in ground the mounting plate with anchors should be installed in top part of pile. Thus, height of lighting fixture from road surface will be approximately 11.0m.

On bridges installation of lighting posts should be made in space of existing handrails. For this purpose the handrails should be cut out on width of post and support plate with anchors should be installed on pavement. Fixing of support plate on bridge structures should be made with use of chemical anchors and steel dowels. After strengthening of chemical anchors the safe load on each dowel will be equal to 26 kN. Then 10.0m high lighting post should be installed on anchors of support plate. So, elevation of lighting fixture from road surface will be $H=10.10\text{m}$. Marking of this type posts is type "B".

Installation of these posts should be made on reinforced concrete piles vertical axis of which should be on 1.2m distance from road edge.

List of Lighting Posts of Road Lighting Network

#	Name of substation, Name of outgoing line	Number of posts	Numbering of H=11m high lighting posts	Numbering of H=10m high lighting posts (Type B)	Numbering of H=11m high lighting posts on Bridges (Type C)	Grounding
1	2	3	4	5	6	7
1	Substation #1					
	LV-1	13	# 4 ; # 1 ; # -1 # ;	-	-	
	LV-2	14	# 5 ; # 18	-	-	
	LV-3	13	-	# 1-1 ; # 1-13	-	#1-10; # 1-13
	LV-4	19	-	# 1-14; # 1-32	-	#1-26; # 1-32
2	Substation #2					
	LV-5	20	# 19 ; # 38	-	-	#19
	LV-6	22	# 39 ; # 60	-	-	#60
3	Substation #3					
	LV-7	23	# 61 ; # 84	-	-	#61
	LV-8	23	# 85 ; # 107	-	-	#107
	LV-9	29	-	# 3-1 ; # 3-39	-	#3-1; #3-3; #3-20; #3-23
4	Substation #4					
	LV-10	20	# 108 ; # 127	-	-	#108
	LV-11	22	# 128 ; # 149	-	-	#149
5	Substation #5					
	LV-12	26	# 150 ; # 175	-	-	#150
	LV-13	19	# 179 ; # 194	-	-	#194
	LV-14	16	-	# 5-1 ; # 5-16	-	#5-12; #5-16
	LV-15	21	-	#5-17; # 5-37	-	#5-30
6	Substation #6					
	LV-16	19	# 195 ; # 213	-	-	#195
	LV-17	21	# 214 ; # 234	-	-	#234
7	Substation #7					
	LV-18	21	# 235 ; # 255	-	-	#235
	LV-19	20	# 256 ; # 275	-	-	#275

8	Substation #8					
	LV-20	9	# 276 ; # 284	-	-	#276
	LV-21	25	# 285; #299; #304; # 305	-	#300; #303; #300*; #303*;	#305
	LV-22	25	-	# 8-1 ;# 8-25	-	#8-1; #8-25
9	Substation #9					
	LV-23	21	# 306 ; # 326	-	-	#306
	LV-24	23	# 327; # 344; # 347	-	#345; #346; #345*; #346*;	#347
10	Substation #10					
	LV-25	21	# 348 ; # 368	-	-	#348
	LV-26	21	# 369 ; # 389	-	-	#389
11	Substation #11					
	LV-27	20	# 390 ; # 409	-	-	#390
	LV-28	23	# 410 ; # 432	-	-	#432
12	Substation #12					
	LV-29	24	# 433 ; # 456	-	-	#433
	LV-30	21	# 457 ; # 477	-	-	#477

0.4kV Lighting Network

Ruisi-Agara-Agara By-pass highway road lighting design is prepared with account of requirements of the Rules of Installation of Electrical Equipment” (ПЙЭ), Construction Standard СНиП 23-05-95 “Natural and Artificial Lighting”, EN13201 European standard and !0=H8H-2.2.1/2.1.1.1278-03 norms. Norms of lighting, restrictions on light flow from lighting fixtures, lighting pulsations and other qualitative parameters of lighting equipment and lighting systems are taken into account according to requirements of normative documents enforced in Georgia. Selected lighting fixtures comply with fire safety norms.

In accordance with the Rules of Installation of Electric Equipment for lighting network the TN-C system of grounding is used (Article 1.7.61). For efficiency of TN-C system the conductors should be indissoluble and safely connected to ground. Cross section of Neutral conductor is the same as cross section of Live (Phase) conductors (Article 6.1.31). Grounding of metal housing of lighting fixtures is arranged by connection of grounding pin to PE conductor.

Metal posts that are installed on reinforced concrete foundations have connection to steel structure and steel bar reinforcement mesh of the foundation. Entrance of cables into body of posts is arranged via socle of post. Connection clamps and fuse (or single-pole automatic switch) are placed in the socle (Article 6.3.33). Wiring inside the body of post should be made with insulated wires in protective coating (double insulation) or with 3x2.5 mm² cables (Article 6.3.34).

Secondary grounding of lighting posts is arranged at terminal posts of network - #9, 18, 1-10, 1-13, 1-26, 1- 32, 19, 60, 61, 107, 8-1, 8-3, 8-29, 8-23, 108, 149, 150, 194, 5-12, 5-16, 5-30, 5-37, 195, 234, 235, 275, 276, 305, 8-1, 8-25, 306, 347, 348, 389, 390, 432, 433, 477 (38 posts in total). Grounding circuit is made of vertical grounding bars (steel angle bars 40x40x4 mm, length 2m) and grounding conductors (steel Æ8mm bar, length 1m).

On the bases of calculation of illumination and lighting fixtures proposed by the Project Owner the following lighting bulbs were selected: 150W power rating bulbs for I category road and 105W power rating bulbs for II-III category roads.

Elevation of light sources from road surface was determined on the basis of light-technical calculations with account of normative illumination requirements, power rating of light bulbs, distances between lighting posts and width of road. These calculations allowed selection of height of lighting posts and elevation of lighting fixtures from road surface.

For I category roads and 40m distance between posts the illumination levels were calculated for three values of height of lighting posts – 12m, 11m and 10m. By technical parameters 10m high lighting posts were selected.

For II and III category roads (road junctions) distance between posts and height of lighting posts was selected with the same values. On the basis of illumination requirements 105W power rating light bulbs were selected.

0.4kV voltage road lighting network should be made with use of BBГ-1 or NYЯ-j-1 type copper cables with plastic insulation.

Installation of 0.4kV voltage road lighting network should be performed together with installation of 10kV feeding network – first the common cable trench should be dug between protective barriers in the demarcation strip, then 10kV voltage cables installed in trench and then 0.4kV voltage lighting network cables should be installed above them. In sections where there are no 10kV feeding network cables the 0.4kV voltage lighting network cables can be installed independently.

On bridges 0.4kV voltage road lighting cables should be installed in corrugated PVC pipes fixed on bridge structures by special brackets (hungers) and dowels.

Cross sections of 0.4kV voltage road lighting network cables were selected with account of possible overheating and permissible voltage losses ($<5\%$).

Guarantee Terms and Conditions

The contractor should present a guarantee on the Following items specified below with coverage of 5 years. The Guarantee should cover all cases, except damage caused by misuse of the equipment by the employer or person action on its behalf (including mechanical damage)

- 10 kv voltage branch lines (ПЛДН 1-10/200; ОПН-10)
- 10 kv metering unit (disconnecter, ОПН-10, power transformer, voltage transformer, Vacuum switch, meter box)
- 10/0,4 kv packaged transformer substation (10/0,4 kv voltage transformer, 10 kv - equipment, 0,4 kv- equipment)
- 0,4 kv automatic switch (durability)
- 10 kv, 0,4 kv power cables
- Panel of outdoor lighting posts (automatic switch, clamps)
- Outdoor lighting posts H=10m; H=9 m
- LED light fixtures for outdoor illumination

BILLOFQUANTITIES

A. Preamble

1. The Bill of Quantities shall be read in conjunction with the Instructions to Bidders, General and Particular Conditions of Contract, Technical Specifications, and Drawings.
2. The quantities given in the Bill of Quantities are estimated and provisional, and are given to provide a common basis for bidding. The basis of payment will be the actual quantities of work ordered and carried out, as measured by the Contractor and verified by the Engineer and valued at the rates and prices bid in the priced Bill of Quantities, where applicable, and otherwise at such rates and prices as the Engineer may fix within the terms of the Contract.
3. The rates and prices bid in the priced Bill of Quantities shall, except as otherwise provided under the Contract, include all construction equipment, labor, supervision, materials, erection, maintenance, insurance, profit, taxes, and duties, together with all general risks, liabilities, and obligations set out or implied in the Contract.
4. A rate or price shall be entered against each item in the priced Bill of Quantities, whether quantities are stated or not. The cost of Items against which the Contractor has failed to enter a rate or price shall be deemed to be covered by other rates and prices entered in the Bill of Quantities.
5. The whole cost of complying with the provisions of the Contract shall be included in the Items provided in the priced Bill of Quantities, and where no Items are provided, the cost shall be deemed to be distributed among the rates and prices entered for the related Items of Work.
6. General directions and descriptions of work and materials are not necessarily repeated nor summarized in the Bill of Quantities. References to the relevant sections of the Contract documentation shall be made before entering prices against each item in the priced Bill of Quantities.
7. Provisional Sums included and so designated in the Bill of Quantities shall be expended in whole or in part at the direction and discretion of the Engineer in accordance with the Conditions of Contract.

B. Work Items

1. The Bill of Quantities usually contains the following part Bills, which have been grouped according to the nature or timing of the work:
Bill No. 1 –
Bill No. 2 –
Bill No. 3 –
Bill No. 4 - etc., as required;
Summary Bill of Quantities.
2. Bidders shall price the Bill of Quantities in local currency only.

Bill of Quantities

Under the basis of summary sheet volumes for Lighting works (Volume II, part I), companies, participating in bid shall present cost-estimation part. Bill of Quantities in excel format without prices is uploaded in the state E-Procurement system.

Section IX - Particular Conditions of Contract

A. General	
GCC 1.1 (d)	The financing institution is: The World Bank – IBRD loan
GCC 1.1 (s)	<p>The Employer is Roads Department of the Ministry of Regional Development and Infrastructure of Georgia</p> <p>12A Kazbegi ave. Tbilisi, Georgia</p> <p>The authorized representative is:</p> <p>Mr. Nugzar Gasviani, First Deputy Chairman of the Roads Department of Georgia</p>
GCC 1.1 (v)	<p>The implementation period is:</p> <p>Intended Completion Date for the whole of the Works shall be 5 months from the start date.</p>
GCC 1.1 (y)	The Project Manager is: TBD
GCC 1.1 (aa)	<p>The Site is located at:</p> <p>E-60 Highway Ruisi-Agara-Agara Bypass (Lot 1) km95 - km114</p>
GCC 1.1 (dd)	The Start Date shall be: Upon written notification of the Project Manager to the Contractor
GCC 1.1 (hh)	<p>The Works consist of:</p> <ul style="list-style-type: none"> • Installation of 10kV voltage branch lines and commercial metering units • Selection of power capacities and location of 10/0.4kV voltage transformer substations • Working out of 10kV voltage feeding cable network • Working out of 0.4/0.23kV voltage road lighting network • Other works/services as stated in the Contract documents
GCC 2.2	Sectional Completions are: None
GCC 3.1	<p>The language of the contract is English.</p> <p>The law that applies to the Contract is the law of Georgia</p>
GCC 5.1	The Project Manager may not delegate any of his duties and responsibilities.
GCC 8.1	Schedule of other contractors: None

GCC 13.1	<p>The minimum insurance amounts and deductibles shall be:</p> <p>(a) For the Works, Plant and Materials: 110% of the accepted contract price</p> <p>(b) For loss or damage to Equipment: 300,000 GEL</p> <p>(c) For loss or damage to property (except the Works, Plant, Materials, and Equipment) in connection with Contract 100,000 GEL</p> <p>(d) For personal injury or death:</p> <p>(i) of the Contractor's employees: 150,000 GEL</p> <p>(ii) of other people: 150,000 GEL</p>
GCC 14.1	Site Data are: None
GCC 20.1	The Site Possession Date shall be confirmed by the Project Manager with a written notification to the Contractor.
GCC 23.1 & GCC 23.2	<p>Appointing Authority for the Adjudicator:</p> <p>"International Arbitration Court of the Georgian Chamber of Commerce and Industry".</p> <p>Address: 29 Berdzeni Str., Tbilisi, Georgia</p> <p>Tel: (995 32) 272-07-10</p> <p>Fax: (995 32) 272-31-90</p>
GCC 24.3	Hourly rate and types of reimbursable expenses to be paid to the Adjudicator: Hourly fees 120 USD (One hundred and Twenty United States Dollars) and travel and accommodation expenses accordingly with actual cost.

GCC 24.4	<p>For contracts with the contractors from the Employer's country:</p> <p>Institution whose arbitration procedures shall be used: _____</p> <p>"International Arbitration Court of the Georgian Chamber of Commerce and Industry".</p> <p>Address: 29 Berdzeni Str, Tbilisi, Georgia</p> <p>The place of arbitration shall be: Tbilisi, Georgia</p> <p>For contracts with the international contractors:</p> <p>“Rules of Conciliation and Arbitration of the International Chamber of Commerce (ICC):</p> <p>All disputes arising in connection with the present Contract shall be finally settled under the Rules of Conciliation and Arbitration of the International Chamber of Commerce by one or more arbitrators appointed in accordance with said Rules.”</p> <p>The place of arbitration shall be: Paris, France</p>
B. Time Control	
GCC 26.1	The Contractor shall submit for approval a Program for the Works within 14 days from the date of the contract signing.
GCC 26.3	<p>The period between Program updates is 60 days.</p> <p>The amount to be withheld for late submission of an updated Program is 10,000 GEL (Ten Thousand Georgian Lari).</p>
C. Quality Control	
GCC 34.1	The Defects Liability Period is: 365 days.
D. Cost Control	
GCC 44.1	NOT APPLICABLE
GCC 45.1	The Contract is not subject to price adjustment.
GCC 46.1	The proportion of payments retained is: 5%
GCC 47.1	The liquidated damages for the whole of the Works are 0.1 percent per day of the final Contract Price . The maximum amount of liquidated damages for the whole of the Works is 10 percent of the final Contract Price.
GCC 48.1	The Bonus for the whole of the Works is : None

GCC 49.1	<p>The Advance Payment shall be: 20% of the contract price and shall be paid to the Contractor no later than 28 days <u>after receipt and approval of the Advance Payment Security</u>.</p> <p>The amount of the Advance Payment security shall be of the same value and currency as the Advance Payment amount, and shall be in the form provided in the bidding documents. Advance Payment Security shall be issued ONLY from local commercial Banks operating on the territory of Georgia.</p> <p>The reimbursement of the Advance Payment shall start when the value of Works executed reaches 20%.</p> <p>Formula to calculate the amount of advance payment to be reimbursed in each payment:</p> $Z = \frac{A * (x\% - y\%)}{80\% - B\%}$ <p>Z= The amount to be deducted in the calculated period. A= Expresses amount of deposited Advance Payment. X= Works performed in the calculated period divided by the initial contract amount expressed in percentage. This value shall not exceed 80%. Y= The same but for the previous period. B= 20%</p> <p>The Contractor will finish the total reimbursement of the Advance payment when the value of the Works executed reach 80% of the Works Value.</p>
GCC 50.1	<p>The Performance Guarantee shall be provided to the Employer as an unconditional Bank Guarantee from the Bank acceptable for the Employer.</p> <p>The form of the Performance Security shall be in the form provided in the bidding documents in the amount of ten percent 10% of the Total Contract amount.</p> <p>Performance Security shall be issued ONLY from local commercial Banks operating on the territory of Georgia.</p>
E. Finishing the Contract	
GCC 56.1	<p>The date by which “as built” drawings are required is the date of Completion Date in accordance with GCC Sub-Clause 56.1.</p>
GCC 56.2	<p>The amount to be withheld for failing to produce “as built” drawings by the date</p>

	required in GCC 56.1 is 10,000 GEL (Ten thousand Laris)
GCC 57.2 (g)	The maximum number of days is: 100 days.
GCC 58.1	The percentage to apply to the value of the work not completed, representing the Employer's additional cost for completing the Works, is 20%

SAMPLE FORMAT:

Invitation for Bids

GEORGIA

Forth East-West Highway Improvement Project (EWHIP-4)

Contract Title: Procurement of Ruisi-Agara-Agara Bypass (Lot 1) km95 - km114 Section Road Lighting Network Installation

Bid invitation No.: EWHIP-4/CW/NCB-04

1. Georgia has received financing from the World Bank toward the cost of the **Forth East-West Highway Improvement Project (EWHIP-4)**, and intends to apply part of the proceeds toward payments under the contract for **Procurement of Ruisi-Agara-Agara Bypass (Lot 1) km95 - km114 Section Road Lighting Network Installation**.
2. The project implementing agency, the Roads Department of the Ministry of Regional Development and Infrastructure of Georgia now invites eligible bidders to submit their bids for execution of above mentioned works. Implementation period for execution of Road Lighting Network Installation is **5 months**.
3. The estimated cost of proposed works is **GEL 5,323,230.00** including all taxes, duties and other governmental levies as elaborated under clause ITB - 14.7. However, it is the responsibility of the bidder to submit a bid price, which could be below or above the estimated cost, based on the current market prices and any other factors which may influence the pricing of the proposed works.
4. Bidders shall meet the following minimum qualifying criteria to qualify for award of the contract:
 - a. Minimum average annual construction turnover of **GEL 2,500,000** calculated as total certified payments received for contracts in progress and/or completed within **the last 3 years (2013, 2014 and 2015), divided by 3 years**.
 - b. Experience as prime contractor, joint venture member, management contractor or sub-contractor in the construction of at least one work of a nature and complexity equivalent to the works between 1st January 2009 and application submission deadline (works should be substantially completed) with a value of (a) one (1) contract of minimum value **GEL 1,500,000** or two (2) contracts **minimum of total value GEL 1,500,000 of lightning roads, streets, public squares or buildings**.
 - c. The evidence that the bidder is not involved in any litigation with regard to its bankruptcy, reorganization or liquidation;
 - d. Liquid assets and/or credit facilities, net of other contractual commitments and exclusive of any advance payments which may be made under the Contract, of no less than **700,000 GEL**.
 - e. Additional Qualification Criterion as defined in Section III – Evaluation and Qualification Criteria of Bidding Documents.
5. A complete set of bidding documentation in English language in electronic format can be downloaded for free

6. Bids shall be submitted electronically as outlined in ITB 25.1. Late bids will not be accepted. Deadline for electronic bids submission is as stated in the State E-procurement system. Government procurement procedures SHALL NOT apply for this procurement.

Bid submission and bid opening will take place electronically using Georgian E-Government Procurement System with certain modifications. Major modifications to the Georgian E-Procurement System are:

- Functionality of the three rounds of e-Reverse auction is removed. Rounds will not be applicable.
- The estimated cost of the contract is disclosed in the e-Procurement system and bidders can submit a bid price, which could be below or above the estimated cost, however pricing the bid is the responsibility of the bidder which shall be based on the current market prices and any other factors which may influence the pricing of the proposed works.
- Please note that bidding is conducted under National Competitive Bidding procedures as specified in the World Bank's Guidelines: Procurement of Goods, Works and Non-Consulting Services under IBRD Loans and IDA Credits & Grants by World Bank Borrowers January, 2011 revised July 2014 ("Procurement Guidelines"). Requests for clarification should be submitted through the Georgian E-Government Procurement System.

7. All bids should be submitted together with the Bid Security Declaration. Bid Security Declaration shall be valid for 28 days beyond the validity of the Bid (i.e., 90 days+28 days = 118 days). For bids submitted by a JV bidder shall carefully read ITB 19.8 as failure to comply with this ITB may be grounds for bid rejection.

8. The Employer's address:

Attention: **Giorgi Seturidze, Chairman of**

Roads Department of the Ministry of Regional Development and Infrastructure of Georgia

Street Address: ***12 A. Kazbegi ave.***

City: ***Tbilisi, 0160***

Country: ***Georgia***

Telephone: **+995 322 370508 (ext. 218)**

Facsimile number: **(995 32) 231 30 34**

Electronic mail address: **info@georoad.ge**