UZBEKISTAN: ENERGY EFFICIENCY IN WATER UTILITIES

ENERGY AUDIT AND PRE-FEASIBILITY STUDY FOR NAMANGAN CITY SUVOKOVA

CONSULTANCY SERVICE ASSIGNMENT (FIRM)

TERMS OF REFERENCE

BACKGROUND

Much of Uzbekistan's water supply and sanitation infrastructure, built during the Soviet central planning era, has reached the end of its economic life and requires extensive rehabilitation and renewal. Obsolete and degraded infrastructure has led to inefficient use of scarce water and energy resources and high operating costs. These challenges along with institutional capacity constraints and limitations to sector financing are affecting operational and financial sustainability of water utilities. Continuous demographic growth and expansion of urban areas are putting more pressure on water utilities to provide efficient water services.

The Government has recently embarked on major sector reforms to support universal access to safe, reliable and sustainable drinking water and sanitation services. As part of this, there is a clear desire to improve operational efficiency and financial sustainability whilst maintaining affordability, especially for low income consumers. This reform program assigns more responsibility to central authorities to oversee investment planning and monitor performance of water service providers (Suvokovas or utilities).

The sector reform is being implemented in a phased approach and was launched in January 2016, through the creation of "regional utilities" or State Unitary Enterprises – "Suvokova". However, utilities are still struggling to generate sufficient revenues to cover the costs of capital investments and as such new investments for system expansion and rehabilitation are predominantly financed by or through the central government. Further actions are required to encourage and enable water utilities to be financially self-sufficient and to act on their own responsibility in pursuing innovative approaches to develop, operate and maintain the water and sanitation systems.

Water utilities are one of the largest consumers of energy within municipalities. The share of energy consumption in total operating costs is significant, often exceeding 30 percent, which affects financial sustainability of utilities. Improving energy efficiency, reducing energy consumption, and managing energy demand will contribute to improved cost recovery in the water sector and ultimately improved services. The proposed activity will explore potential energy efficiency improvements to reduce energy usage and operating costs.

This Consultancy Services assignment is funded by the Energy Sector Management Assistance Program (ESMAP) with the aim to facilitate investments to improve energy efficiency and sustainability of water supply and sanitation service delivery in Uzbekistan. It is expected that the outputs of the Energy Efficiency Audits and Pre-feasibility assessments will contribute to the proposed World Bank-financed Water Services and Institutional Support Program and by highlighting key benefits of energy efficiency investments, will be used as a demonstration to inform and strengthen the Government's on-going sector reforms.

More specifically, this assignment includes an energy audit and preparation of pre-feasibility studies for Namangan city water and sewerage utility.

CONTEXT – NAMANGAN CITY & EXISTING SITUATION OF WATER & SEWERAGE

Namangan city is the administrative center of the Namangan region of the Republic of Uzbekistan. The second largest city in Uzbekistan after Tashkent. Namangan is located in the northern part of the Fergana Valley, 200 km southeast of Tashkent (on the road about 300 km). Height 476 m above sea level.

The city terrain is characterized by undulating hills, with intersecting ravines. Altitude differs between the northern and southern boundaries of the city, from the south-east to south-west the range is from 660 to 410 m in elevation.

The territory of the city prior to 2016 was 101.5 km². In 2016 however, parts of the territory of Namangan, Ujchi and Yangikurgan districts were joined to the city, as a result of which the area of the city grew to 145 km².

The population as of October 1, 2017 was 597.4 thousand people. The population density is 4,120 people/km². The total number of households is 101,956 including 669 multi-story residential buildings (3-7 floors) with 26,642 apartments. The number of individual private houses in Namangan is 72, 319.

Namangan SUE "Suvokova" has relatively high energy consumption (3-5 times higher than in other regional utilities) for the water supply and sewerage systems.

The water supply system currently serves around 94% of the city's population (563,900 persons). The water supply system is divided into Northern (upper) and Southern (bottom) zones. Water is sourced from three water intake facilities: Kyzyl Ravat water intake facility (surface), Jiydakapa water intake facility (ground) and Kurashkhona water intake facility (surface), with a total designed capacity of 368,000 m^3/day.

In 2017 these facilities produced 42,3 million m^3 of water for Namangan city. The average water consumption is 111 liters per person per day. Water consumption during the day is uneven: reducing to minimal amounts at night, with peak periods in morning and evening hours. As pumps operate continuously with the same power during the day, water pressure within the system dramatically increases during the hours of reduced consumption, and drops during peak hours. Water consumption also varies significantly by season.

In total, 106 pumping units have been installed in the water supply system of the Namangan city, including 68 pumps at water intake facilities and 38 pumping units at booster pumping stations of 2-4 levels. Some pumping stations operate in cascade, and water is pumped up to 4-5 times. Some of these pumping stations operate intermittently providing water to the consumers several hours a day, which is partly attributed to high electricity costs. The total power consumption of these facilities in 2017 was 63.5 million kWh. Average electricity consumption for water production is about 1.5 kWh/m^3 which is significantly higher than the average of other regional water utilities, 0.4-0.5 kWh/m^3.

The pumping equipment, installed at various intervals between 1985-1997, is ageing and in deteriorated condition, with various forms of inefficiencies. Pumps are not equipped with frequency controllers and do not respond to changes in water consumption. The power supply system is also in poor condition.

Due to the failure of shut-off valves, the hydraulic operation of the pipeline system in the city is practically not regulated. There is no water pressure monitoring and control system for the water supply networks. This results in excessive pressure or shortage of water in different parts of the water network. Excessive pressure in the system in hours of minimal intake leads to high water losses.

The assignment will help to support the utility to resolve the issues associated with the suboptimal operation of the water supply system and inefficient use of energy and water.

Sewerage treatment facilities, collection and conveyance system of the Namangan city are also managed and operated by the Namangan SUE "Suvokova". The existing infrastructure was brought into operation in 1963. The sewerage system of the city is of a separate type and is not designed for storm water collection. Approximately 15% of the city is covered by the sewerage system.

Installed capacity of Namangan sewerage treatment plant is 100,000 m^3/day, but actual operating capacity is around 45-50,000 m^3/day. A recent condition survey sewage treatment facility, indicates that around 80% of the mechanical and electrical equipment are substantially affected by wear and tear and in need of replacement. The status of 2 sewage pumping stations and the sewerage collection system of the city of Namangan is also substantially deteriorated.

Further details with respect to Namangan city water supply and sewerage system are contained in a Rapid Assessment Report prepared by the Bank team prior to launching this assignment. To further inform the preparation of the Consults proposals, this has been included in Annex 2 of this TOR.

OBJECTIVE

The objective of this assignment is to explore options to unlock energy efficiency and demand management potential of Namangan city water supply and sewerage utility by analyzing its energy performance indicators and identifying energy savings and load shifting options. The energy audit and pre-feasibility assessments will involve an analysis of the existing situation and identification of cost effective operational adjustments and short-term low-cost energy efficiency recommendations. Thereafter, an action plan for the interventions is to be developed to improve energy efficiency. This plan should not only include capital investments, but integrate recommendations to enhance the capacity of Namangan city for data collection, analysis and operations. In addition, in view of the high energy footprint per unit volume of water delivered by the utility, the proposed audit shall also include an assessment of outages faced by the water utilities, any time-based penalties they end up paying to the electricity supply company and any collaboration the water utility can establish with the electricity utility to establish co-benefits of shifting pumping operations to off-peak and therefore less expensive periods of electricity generation to reduce the costs of electricity generation and distribution.

Moreover, this assignment is designed to determine opportunities for cost savings and operational and financial performance improvements by analyzing past and current energy use and establishing reliable and accurate baseline for measuring future results of efficiency efforts.

SCOPE OF WORK

This Consultancy Assignment consists of three primary and interrelated tasks: (1) Energy Efficiency Audit; (2) Analysis of Time-of-Use of pumping operations to identify options to reduce electricity costs; and (3) Pre-feasibility studies for energy efficiency and load management investments.

The Scope of Works for the Consultant under each task is described further below.

Task 1: Energy Efficiency Audit

To carry out the energy efficiency audit, the Consultant shall collect and analyze both technical and financial data such as historical energy consumption, equipment inventory including technical characteristics of pumps used, energy use by each facility (kWh), electrical, mechanical and process

systems, electricity costs, electricity bills, operation and maintenance costs. The analysis will identify the most energy intensive equipment/processes, their impact on total costs and highlight potential areas of energy savings. A breakdown of energy consumption and costs shall be determined, based on an assessment of the existing systems. This assessment is intended to inform the identification and prioritization of interventions (both physical and institutional) to improve energy efficiency and reduce costs of utility operations.

The Consultant shall assess the power supply system of the water intake facilities and pumping stations and recommend measures on how to improve the reliability of the system operation and maintain optimal pressure at control points.

This shall also include review of design capacity for each facility. Monitoring of pumping stations will be required with measurements of the water volume and pressure. Optimal hydraulic operating regime shall be identified by evaluation of the water distribution network, pressure measurements at key points. The recommendations should also consider automatic regulation of the volume and pressure of supplied water to the network depending on the time of the day and volume of water consumption. Exit water flow and pressure shall be managed based on the changes in the rotation rate of the pumping unit and installation of a variable frequency drive. The Consultant shall also recommend the pumping equipment with technical parameters which will be appropriate for the existing water supply system and installation of automatic water supply systems with frequency converters.

The assignment will include data collection (document and data reviews, field measurements and other onsite assessments – as required), information analysis, identification and evaluation of energy saving options. More specifically, the Consultant shall carry out the tasks which include but are not limited to the following:

- Develop a detailed methodology including instrumentation plan for undertaking energy audit, consistent with relevant international standards and best practices;
- Conduct inventory and evaluation of the relevant aspects of the utility operations, including technology used, general state of infrastructure / equipment and number and type of facilities, level of water losses, characterization of relevant service issues, demand and water production analysis considering climate and seasonal variations, analysis of key system components etc;
- Collate and analyze electrical system data as relevant, including power supply data, voltage, monthly billing, maximum demand, consumption (kWh/month), electromechanical infrastructure (electrical intake, substation, transformers, measuring equipment, electrical motor system (design power, supply voltage, speed at full load, original and actual efficiency, operating temperature, aging), pumping and electrical equipment and facilities, valves, electrical and mechanical systems (number and type, model, age, current operating condition, loads, hour of operation, reliability and frequency of O&M);
- Collect and review other necessary baseline and historical data and analyze information on water supply and energy consumption over the last 3 years;
- Due to possible existing data constraints, the Consultant is expected to carry out actual field measurements within relevant aspects of the system to calibrate and/or further develop the assessments. This may include volumes of water supplied at various points in the systems, pressures at pump stations and various sections of the water supply system, energy consumption at pumping stations, etc.
- Examine the operating regimes of production and distribution facilities, with respect to their impacts on energy consumption and potential efficiency gains.

- Estimate energy losses in conductors and transformers, motor efficiency, pump efficiency and losses, head losses in pipelines, leakages in the network, and energy indicators.
- Compile and present findings of the analysis, including identification of issues and focus areas – considering both infrastructure/equipment and institutional aspects for improved operational efficiency.

Task 2: Analysis of Time of Use of Electricity

This task shall include assessment of electricity bills paid by the water utility, specifically from the point of view of assessing the demand/capacity charges paid and any penalties incurred during the peak-demand timings coincident with high electricity demand on the electricity distribution system. The specific tasks expected to be carried out by the consultant are presented below:

- Analyze bills paid for by the utilities for previous 3 years; plot the monthly bills clearly showing the demand and energy charges paid by the water utility on account of varying levels of electricity consumptions in main and booster pumping stations
- Collate data from the electricity utility on the daily load-shapes of the water pumping systems clearly identifying seasonal variations
- Analyze the electricity utility tariff structures from the point of view of any penalties charged and incentives offered for on-peak and off-peak electricity consumption
- Interview the electricity utility, assess their power procurement agreements, costs they incur during the on-peak and off-peak time of uses and potential cost savings by reducing demand during peak periods
- Collate information on water storage available as "reserve margin" available within the water pumping network represented as percentage of daily capacity pumped from source to the end-uses
- Understand differences between large bulk water users (large industries) and balancing reservoirs through the entire system to assess their ability to reduce water requirements on critical time-zones and if they can offer any relief in the water pumping processes
- Assess the potential to shift the pumping hours from on-peak to off-peak and create simple spreadsheet tool to understand the benefits the water utilities would be able to harness during the periods where they are able to shift the water pumping timings
- Assess the presence of any market-based energy market in the country and study if there is any potential to monetize changed time-of-use of electricity through a demand-response initiative where the water utility would offer relief to the electricity markets and get those efforts (of shifting the loads) monetized through a Demand Response initiative
- Suggest demand management protocols to promote a permanent load shift through simple heuristics/rules drawn out for management of pumping hours, optimized use of holding capacities etc.

Task 3: Energy Efficiency and Load Management – Pre-feasibility Study

Building upon the results of audit assessments the consultant shall conduct pre-feasibility analysis to translate key findings into prioritized investment plans – considering both institutional and infrastructure / equipment requirements to improve efficiency of utility operations. During this process the consultant is expected to carry out the following tasks:

- Further develop the analysis of the current state of infrastructure and utility operations by updating existing data as necessary. This may include development of energy and water balance models, and

hydraulic modeling of the water supply system with different scenarios of water consumption and operation of pumping stations.

- Identification of investment needs– considering key infrastructure and equipment for improved efficiency (e.g leakage and pressure control, pump replacements and other distribution system modifications) – along with utility operational aspects. As part of this analysis consider optimization options for water supply system and prioritize measures that will allow quick payback of investments: effective operation of pumping stations, optimal distribution of water in the network with water pressure control; reduction of load on electricity network in the peak load period, etc.
- Preliminary calculation of life cycle cost estimates for identified investments;
- Cost-benefit and financial analysis of various investment options. Including calculation of payback periods (through energy and other savings) and potential loan repayment schedules;
- Review and document potential environmental or social impacts– important for consideration in the decision-making processes.
- Based on the technical, economic and financial analysis, along with other institutional, environmental and social considerations, develop a prioritized investment program.
- Development of pre-feasibility level designs / specifications and cost estimates for priority investments.
- Preparation of implementation plan for physical investments.
- Preparation of proposed adjustments to operational procedures and regimes for energy efficiency utility operations.
- Identification of key areas for capacity building, training and for more energy efficient utility operations
- Presentation of findings / proposal to key stakeholders.

SPECIAL CONDITIONS

The Consultant shall provide all necessary tools and equipment for data collection, measurement and analysis – including – as necessary mobile water pressure and flow measurement instruments, devices to measure technical parameters of electric motors, leak detection equipment and other materials and equipment necessary to perform the energy audits and pre-feasibility assessments.

In addition, in accordance with the Resolution of the Cabinet of Ministers No. 164 dated 07/08/2006 "On Approval of Rules for Energy Audit and Expertise of Consumers of Fuel and Energy Resources", before carrying out energy audits and expertise, the Energy Auditor (Consultant) should prepare a “Program for conducting energy audits and expertise” and have it approved with the Consumer of energy resources (SUE "Suvokova").

STAKEHOLDER INVOLVEMENT

<u>Ministry of Housing and Communal Services (MHCS) and Kommunkhizmat Agency</u>

The Consultant shall communicate with the MHCS and Kommukhizmat Agency at relevant intervals during the assignment, and present key findings and recommendation for their review and inputs.

<u>Namangan SUE “ Suvokova” management and staff</u>

The Consultant shall work closely with Namangan City SUE “Suvokova”, the key beneficiary of the assignment outputs. The Consultant shall utilize Suvakova’s knowledge, experience and existing data (to extent possible) and involve them in the analysis to ensure validation and ownership of key recommendations and proposed investments.

During the inception phase the Consultant shall meet Namangan SUE “Suvokova” management to explain the objectives, scope of the assignment and data and assistance required for the audit. The meeting will help to establish operating characteristics of the facilities, energy system specifications, operating and maintenance procedures, operating constraints, and areas of concern. Namangan SUE “Suvokova” management shall also be informed about the findings of the energy audit and consulted upon potential energy saving options.

Namangan SUE “Suvokova” will be requested to assign a small team to work with the Consultant which will include experienced as well as young specialists. The Consultant shall encourage active involvement of assigned “Suvokova” specialists in data collection, including in water pressure and flow measurements. “Suvokova” employees shall ensure safety of works and facilitate in getting access to facilities and equipment. Where necessary, Suvokova will arrange site access and digging of the required section of the pipeline for flow measurements and inspections.

During the initial stages of the assignment, the SUE "Suvokova" will facilitate all necessary preliminary approvals with other partner organizations, for example, with the power supply company “Uzbekenergo”.

The Consultant shall demonstrate energy use assessment methods to Namangan SUE “Suvokova” staff that can be used by “Suvokova” to manage energy use and costs. It is expected that the “Suvokova” staff learn through this process through knowledge and skills transfer.

DELIVERABLES

The deliverables shall include: (1) an inception report; (2) energy efficiency audit and energy demand management/ response report; (3) pre-feasibility study report; and (4) completion report. Deliverables shall be prepared in English and Russian and submitted in both hard and electronic format. The Consultant shall incorporate (or respond to) World Bank comments on draft submissions. Furthermore, the draft reports shall be shared with the Namangan SUE “Suvokova” and MHCS for comment.

The Inception Report shall include a detailed methodology for the assignment, documentation of available data and proposed data collection efforts, definition of key issues identified from preliminary desk review and critical path activities, detail data requirements for the analysis, proposed work plan and detailed implementation schedule. The energy efficiency audit report, demand management and demand response report, and pre-feasibility study report shall comprehensively cover all key tasks as defined in the scope of services.

In addition to these reporting deliverables, the consultant is expected to hold at relevant intervals stakeholder workshops (including MHCS, Namangan SUE “Suvokova”, Municipality and others as relevant) to present project status, findings and key recommendations for feedback and endorsement. A final workshop shall be held upon completion of the assignment to present to a broader audience the results of the assessments to demonstrate the process and potential impacts associated with targeted institutional and infrastructure energy efficiency investments. These workshops and other relevant activities/recommendations shall be documented in the Completion Report.

Each report shall contain a concise executive summary with key findings and recommendations – which can be circulated for review by different decision makers.

Ownership of all deliverables shall be retained by the World Bank. The Consultant shall submit to the Bank, all raw data collected during the assignment, including through fieldwork, and supporting calculations for each proposed measure.

COMMENCEMENT DATE AND EXECUTION PERIOD

Date of commencement of consulting services is approximately scheduled on May 2018. Period of Execution is 9 months including the time required for Government / Namangan city SUE "Suvokova" feedback, consultations and workshops.

DELIVERY AND PAYMENT SCHEDULE

№	Deliverables	% of Contract amount	Submission Timing
1	Inception Report	20	After 1 month
2	Energy Efficiency Audit Report and Demand Management/Demand response Report	40	After 5 months
3	Pre-Feasibility Study Report	30	After 8 months
4	Completion Report	10	After 9 months

For all submissions, payments will only be made after approval by the World Bank.

SKILLS AND EXPERIENCE REQUIRED

The Consulting firm selected for this assignment shall be duly qualified, with a track record of experience in the relevant field. The Consultant shall provide information on:

- knowledge and experience working with water supply systems and utility operations;
- capabilities and experience conducting energy audits of water utilities. In presenting such experience the consultant shall highlight the size and scope of the assessments and results - in terms of potential energy savings;
- knowledge of electricity utilities' functioning, understanding of tariff-setting process, and knowledge of demand management and demand response initiatives;
- experience in preparation of pre- or feasibility studies in the water sector;
- availability of experienced and qualified specialists relevant to the assignment, including water supply / hydraulic engineering, electrical engineering, and economic and financial analysis.
- availability or ability to lease relevant equipment for required for field measurements such as mobile flow meter, water pressure devices, devices to measure technical parameters of electric motors, leak detection equipment, etc.;

Respondents can submit proposals in association with or part of a joint venture, in which case this shall be clearly stated in the proposal forms. All parties to the joint venture will have joint and several liabilities for the assignment.

The Consultant shall select and employ experts as required according to the scope of services and delivery schedule for the consultancy assignment. The Consultant is encouraged to use local experts to ensure the local conditions and capacities are best considered. For convenience a list of Uzbek EE Audit companies and design institutes / consultancy firms is included in Annex 1 (note this list is not exhaustive and others may be included. It is the Consultants own responsibility to assess the capacity of the local firms and define their roles and responsibilities in the process).

Language and translation requirements shall be carefully considered.

The Consultant is expected to provide a complete staffing schedule, including commitment levels of senior staff to this project and commit adequate resources for successful completion and submission of all deliverables within the duration of this assignment.

If required by the Government authorities, the Consulting firm selected for this assignment shall be ready to provide all available licenses and certificates for energy auditing work, as well as the relevant permits (permits and licenses) of its specialists for working with certain types of equipment (for example, with electrical equipment).

DATA, SERVICES AND FACILITIES TO BE PROVIDED BY THE EMPLOYER

The World Bank will provide support to the Consultant to establish contacts with the Namangan SUE "Suvokova" and relevant Government representatives. The Bank will also provide general support to enable available data to be released by the Government / Namangan SUE "Suvokova" and will issue invitations to relevant officials to stakeholder workshops.

BID SUBMISSION REQUIREMENTS

Bidders should submit their proposal that include following information:

- Introduction to Consultant Firm (including the Consultants Team)
- Consultant's understanding of the requirements of scope of work
- Detailed Approach and Methodology highlighting plan to implement the stated tasks, concurrency of water/energy audits, methodology to capture data requirements and software tools used to ensure data is available in open formats
- List of all the instruments to be used in the field measurements (owned or hired with the class of accuracies), metering devises to be used with error boundaries, telemetry services that would be deployed in the field to conduct NRW and energy audit studies
- Detailed resumes of the Team Leader, Lead Experts for NRW and Energy Auditing studies, supporting technical staff conducting field measurements, GIS expert, instrumentation/metering experts, financial analysts, procurement experts and engineers capable of developing the concept technical specifications and designs etc
- Detailed week-wise timeline of all sub-activities identifying critical paths in the implementation of core tasks in accordance with the delivery schedule.
- Financial bid that establishes time spent by experts in the field, home-offices, travel and other incidentals etc.

LIST OF ANNEXES

- Annex 1: List of National EE Audit and Engineering Companies
- Annex 2: Rapid Assessment Report – Namangan City

ANNEX 1: LIST OF NATIONAL EE AUDIT AND ENGINEERING COMPANIES

Annex 1.1 – List of Design Institutes and Consulting Companies

Annex 1.2 – List of EE Audit Companies

ANNEX 2: RAPID ASSESSMENT REPORT – NAMAGAN CITY, WATER SUPPLY AND SEWERAGE SECTOR