Terms of Reference: Recruitment of Automation and Control Expert.

1. Introduction and background to the assignment;

Ntaruka, Mukungwa and Nyabarongo hydro power Plants are owned and operated by Energy Utility Corporation Limited (EUCL). Those plants have installed capacity of 11.25MW, 12MW and 28MW respectively.
On 10th February 2019, a blackout occurred and while restoring the system, an unexpected behavior happened on power stations with black start capabilities.

During the incident, units were started up and island formed around some of generating stations by connecting essential loads through 30 KV lines but at the time of connecting 110 kV electric line machine tripped with different alarms "loss of excitation, over speed, etc."

For other power stations, machine was started but tripped immediately at first attempts of connecting load (before forming island).

These such behavior were attributed either to:

- Excessive reactive power from the grid
- Improper setting of governor and excitation
- Malfunction of governor, control and excitation system resulting in hunting, poor excitation etc.

Therefore, the proposed consultant will conduct the tests in the power plants, realize the training of REG EUCL engineering staff and then make recommendations on how to set the speed governors, AVRs and PSS correctly or upgrade them in case one that are installed could not meet requirements.

2. Objective

The objective of the assignment is to investigate the reasons why the National Electrical Network collapsed in 10th February 2019, conducting specialized tests on speed governors and voltage regulators in the hydraulic power plants that failed to maintain stability as part of the grid become islanded, and realizing in collaboration with REG EUCL engineers, the necessary power system studies to ensure the power system stability.

3. Scope of the assignment

The scope of this assignment consists of performing the tests on 3 plants that are major for system restoration and understand their performance regarding

- Transmission circuit loss
- Grid frequency disturbances
- Islanded operation
- Servomotor speed gain/loss

Recommend necessary upgrades/ reconfiguration to properly respond to above scenarios and provide required training to EUCL staffs
Recommend necessary tools EUCL should possess to perform the tests for themselves in future

4. Consultant duties and responsibilities

Under this consultancy and advisory assignment, the consultant will undertake the following duties and responsibilities.

- The consultant shall investigate the causes of blackout occurred on 10th February 2019.
- The consultant shall investigate why the generation and transmission system was unable to sustain the operation in islanded mode.
- Conduct speed governor and voltage regulator, including power system stabilizer, tests in the hydraulic power plants that failed to operate in island and to restart without supply from outside
- Provide training to REG EUCL engineers on tests done and on results analysis;
- Conduct power system stability using the dynamic models identified by the tests in the power plants and the other available data;
- Determine adequate settings of speed governors, AVR and PSSs for ensuring the power system stability, according to the on-site tests and the stability studies;
- Define operation rules such as power transmission limits, generator operating limits, voltage regulation, etc…
- All the activities described above to be conducted in collaboration with REG EUCL engineers and technicians

5. Duration of the assignment

The duration of the assignment is 5 months working together with EUCL team for hands on training and knowledge transfer.

6. Methodology to be used to carry out the assignment

The consultant will describe in his proposal the methodology that he/she intend to use to carry out and complete the assignment. It is expected that he/she will create a computer model for evaluating the speed governor, turbine and excitation system.
The consult will also visit all those power plants for preliminary stability studies to identify the potential weakness of power system and estimate its theoretical capacity to withstand islanded mode of operation.

7. Detail outputs (key deliverables to be accomplished)

The consultant is expected to deliver the following key outputs, in collaboration with technical staff at EUCL/GO&M:

- Computer model for evaluating the speed governor, turbine and excitation system
- The report which details issues caused the plants that failed to start

- Conducting tests in the power plants and realize training of REG EUCL engineering staff.
- Test report and make recommendations on how to set the speed governors, AVR and Power System Stabilizer correctly
- Provide the test bench equipment
- Provide the report with tests results analysis.

8. General experience of the consultant and important aspects of the project to be focused

The consultant should have more than 20 years of practical engineering experience with special focus in areas of power system stability.

9. Competencies and qualification of expert;

The minimum professional and technical standards required are:

- At least a master's degree in electrical, mechanical or electromechanical engineering, a higher level is an added advantage
- Minimum 20 years of work experience in area of power system stability.
- Demonstrated experience in conducting tests for AVR and Power System Stabilizer
- Ability to analyze the tests results, identify necessary settings modifications and provide the recommendations.
- High level of attention to detail
- An excellent command of the English language-both written and oral
- Ability to produce quality work within a deadline and under pressure
- Highly developed reporting skills
- Motivated and can work in a team environment
- Willing to share knowledge with client technical team

10. Set the time periods for the key deliverables identified

The work is expected to start immediately after signature of the contract. A discussion with the client representative to clarify any outstanding issues should be held not later than one week after the signature of the contract.

As an interim deliverable the contractor should submit a draft preliminary report on analysis made based on preliminary data provided by the client before conducting a visit at Mukungwa, Ntaruka and Nyabarongo hydropower plants. This should occur no later than 7 days after the signature of the contract by both parties.

Furthermore, the consultant should hold a presentation at the client premises in Kigali.

The final report shall be provided to the client in soft and hard copies and the whole assignment should be completed in not more than 5months.

11. Services and surveys necessary to carry out the assignments

- Synchronous machine parameters from manufacturers
- Excitation system parameters and model as per manufacturer's documentation
- Turbine parameters and model as per manufacturer's documentation
- Technical description and settings of AVR, PS, and speed governor as per manufacturer's and/or commissioning documentation
- Transmission system data for load-flows and stability studies
- Permission of using the load-flow and stability software programs utilized by REG EUCL

12. Detail the services, facilities and counterpart staff to be provided by EUCL

N/A

13. Reporting arrangement and overall coordination

The consultant will report to the managing director of EUCL.

The consultant will work under supervision of the director of generation. The supervisor will have frequent interactions with the consultant at various stages to brief the consultant on the situation/assignment; agree on the process and clarify the deliverables; provide feedback and comments on intermediary products; and track the progress made by the consultant. The supervisor will evaluate the consultant's work and certify delivery of work.

14. Requirements for transfer of knowledge/ training as part of the assignment

The consultant through an interactive training method will provide a comprehensive understanding of conducting the tests on speed governor, voltage regulator and PSS using proposed test bench equipment as well as analyze the test results.

The training will focus on tests using test bench equipment and on results analysis.

15. Application

Interested candidates are required to submit their technical and financial offer at the following address:

Managing Director of EUCL
KN82ST3, Nyarugenge District, Kigali City
P.O Box 5634 Kigali-Rwanda

Done by:

TWAJAMAHORO J. Providence
Ag. Chief Eng. Power Plant Performance