**Georgian International Energy Corporation**

**Building central SCADA System**

**Technical requirements**

Turn-key solution purchase

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Introducion

This technical task is intended for the creation of SCADA systems at GIG-s power plants. Software complexes of this class are used as an element of automation systems for industrial processes. This moment we are talking about the production of electric energy at the GIG hydro power plants.

There are two stages of purchasing and implementation procedures during which the new automation concept is due to be implemented.

One stage means, which is NOT the subject of the current document, is the creation of local automation and control (hereinafter I&C) and SCADA systems at hydro power plants (hereinafter HP) locally, which consists of:

- measuring sensors (not the subject of the current purchase);

- executive mechanisms (not the subject of the current purchase);

- controllers for collecting data from sensors, their processing and issuing control actions (not the subject of the current purchase);

- local SCADA systems (not the subject of the current purchase);

Another stage means creation of a central SCADA systems (Web-based with subscription, on-premise or hardware-software SCADA platform with remote connection interfaces).

The current document describes technical requirements to the central SCADA system that is due to be installed in the central office of the company and provide access to its functionality to the wide variety of users distributed across different company’s sites.

1. Development basis

Decree No. 10; April 17, 2014, by the Georgian National Commission of Energy and Water. On the approval of the "Network Rules". From this decree, companies engaged in the production of electric power should install SCADA systems at hydroelectric power stations.

From the rules of networks, it should be noted that GIG companies must install SCADA systems at hydro power plants. This moment in the orders of GIG there are 8 hydro power plants. This year it is planned to install SCADA systems at 3 hydro power plants. For the installation of SCADA systems, particular attention should be paid to the following points. №45 on the installation of SCADA systems, № 45.4 On communication networks to ensure the uninterrupted operation of SCADA systems. Compatibility of the SCADA systems of companies, to the SCADA systems used by the central control room. № 45.6 rules and purpose of operation of SCADA systems.

1. Aim and purposes of the central SCADA system

The central SCADA system is required to monitor production processes in hydro power plants in real time, to perform planning and organizational activity, to identify anomalies and failours and to plan service and maintenance activities.

Users of the central SCADA are:

Company management

Planning department

Operation and maintenance department

Human resource department

Power plant operators and management

The purpose of the central SCADA is to digitalize and organize following functions:

1. Technological monitoring

Online monitoring of measurement values ​​and equipment states at all technological areas, as well as data collection and reporting on commercial and technological metering units (electricity, water, etc.):

* operational information: values of the parameters of the production process, violations of the parameters of regulatory boundaries (alarms);
* management of technical equipment and process parameters that took place at hydroelectric power stations: changes in settings and operating modes of control loops, changes in system settings, input of numerical data.

Monitoring the impact of operating personnel on the efficiency of each generating unit in the context of the passport data of each facility and deviations from them. Calculates the impact on the technological process in points, takes into account the ineffective operation of equipment, provides reports on personnel on shifts, taking into account the specified corridors of permitted deviations

1. Measurements and hystorical data analysis

* working with historical data and trends for detailed analysis of events manually or using pre-configured reports on technological parameters.
* archived data: parameter values; text messages about violations of production processes, user actions to manage processes, as well as system messages from all ICS and SCADA subsystems;

1. Productivity planner and load dispatching

Scheduler for the operation of energy facilities, taking into account the available capacities, the possibilities of modes, the size of their auxiliaries. It is also used to interact with the Customer's traders with sending scheduled power load for the upcoming periods to be worked out by correspondent trading operations.

To manage and visualize dispatch function of the load planned and the power produced inline with the distribution of power production tasks among available generation facilities, maintaining a balance, creating and maintaining a load schedule.

1. Online efficiency calculation

Calculates the efficiency for the selected period for each generating unit and for the hydropower plant as a whole. An automated reporting system with adjustable time range is required to be preconfigured and agreed with the Customer to provide reports on:

* Electrical energy produced
* Electrical energy supplied
* Water consumed
* Auxiliaries consumed
* Efficiency calculated/ loses calculated

1. User administration

All users of the central SCADA system must be properly administrated. That means that there must be:

- a pre-registration stage with filling up of a users’ portfoglio page;

- registration with password and login creation by the user himself;

- acceptance by the users of user politics;

- administration panel with permission management which grands users access to the functional plant displays and categorize users to viewers or editors;

1. The structure of the central SCADA system in GIG

According to the requirements of the “network rules”, hydropower plants subordinate to the Hydroenergo department of the company. This stipulates the necessity to organize the SCADA structure in the same manner. Therefore, the central SCADA is organized as a superior high-level system which collects the rough data from the local sources of information, based on hydropower plants belonging to the company.

The souces of informations are the local I&C systems, installed on-sites.

The central SCADA must be able to accept not less than 2000 tags on the initial stage of performance and have the ability for further limitless signal extension.

The lower level systems are the I&C systems 12 hydroturbines with sets of auxiliary equipment in 5 locations in total:

* Alazani 1 HP and Alazani 2 HP (will be eqquipped with local I&C)
* Racha HP and Ritseula HP (will be equipped with local I&C)
* Bzhuzha HP (will be equipped with local I&C later)
* Igoeti HP (will be equipped with local I&C later)
* Tirifoni HP (will be equipped with local I&C later)
* Kakhareti HP (will be equipped with local I&C later)

The central SCADA must include list of HP related plant displays, to be created for each HP individually, and general and functional plant displays, related to all HPs or to general functionality of the system.

HP related individual plant displays include but are not limited to: technological monitoring, states tables, alarms and messages meter listanalysis, efficiency calculation, personnel scheduling, equipment scheduling etc.

General plant displays include but are not limited to: general dashboard, reporting display, efficiency calculation, planners etc.

Reports are due to be customized in the quantity not less than 20 pcs. by individual drafts prepared by the customer in the form of XLS tables.

The central SCADA must be able to receive all the data from local SCADAs through one of the protocols listed here: MQTT, IEC 60870-5-104 or other standard internationally certified protocol which will be the subject of approval by the customer.

The structure and architectures of SCADA are shown in Fig. 1. Data is collected at each hydroelectric station on the basis of an existing server in digital monitoring and control systems. Data is transmitted using 3G or 4G Internet networks.



fig. 1. The basic structure of SCADA.

From the servers of local SCADAs on hydroelectric stations, the data will be transferred to the central SCADA, which will be located in the dispatch of companies. On this server, the company’s dispatcher and central dispatching office will have full access. As for the access level of the central control room, it will be subject to the “network rules” and the central control room agreement.

For the case of on-premise system implementation with server part of the system running on-site of the Customer’s office, a network security solution must be included into the scope of supply. Preferably, the network security solution must provide double firewalling of company network. Firewalls must be from different vendors.

At the moment, and within the framework of this technical task, we plan to equip SCADA systems with only two hydroelectric power stations in one location: Racha, Ritseula, Alazani 1, Alazani 2 HPs. The local SCADAs with PLCs are due to be modernizad within separate projects that are not the subject for the current technical requirements.

1. Requirement for the program and technical means
   1. Functional characteristics requirement

The central SCADA visualization functions should include:

• display of operational and current production process information in numerical, graphical froms (in the form of a mimic diagram of the electrical, mechanical and hydraulic parts, real time schedules);

• alarm about violations of production processes by color, lines, text, a list of violations in a tabular form; display specific graffiti produced by digital devices for protection and control.

• providing archived messages about violations of the production process, actions of the hydroelectric station operator and system ones. Messages should be displayed using various filters: by category, time / date.

The update cycle of operational information on the screen should not exceed 1 second.

The archive must be able to store the data for the period not shorter than 12 month.

The central SCADA system has to be extendable by functionality and objects connected. The objects may vary by type of generation e.g. hydro, PV, wind etc.

* 1. Reliability requirement

Ensuring reliable operation and protection against unauthorized access of the system is implemented at several levels:

• at the level of SCADA as a whole – redundant hardware configuration must be implemented for server and network equipment. In case of a cloud solution – redundant configuration of instances, storages and external communication channels.

The visualization subsystem must satisfy the following reliability requirements:

• continuous operation 24 hours a day and 360 days a year;

• number of errors - no more than 1 per 1000 operators;

• mean time between failures - 1500 hours; maximum recovery time - not more than 8 h

* 1. Information and Software Compatibility Requirement

The SCADA system in the process of its functioning as input uses data from other SCADA subsystems:

• subsystems of parameters - to obtain a list of parameters for the production of electric energy and their attributes, parameter values, process control.

• archive subsystems - for displaying archived values ​​of process parameters and displaying messages about the arrival of various kinds of events.

• Subsystems of digital relays about alarm messages during the production process.

• security subsystems - to obtain a list of registered users during installation and verification of access rights.

It is recommended that you store the configured frames in the production process in xml files, since this format is convenient for storing data about objects in text form.

* 1. Marking and Packing Requirement

To uniquely identify the visualization subsystem in the SCADA system, you must use the version number. The version is presented in the form of three digits separated by a dot, for example, like this: 1.2.3.

The last figure determines the level of stabilization of the system within the framework of the main version. The other two digits form the main version number. If the first digit has 0, then the system is still being developed, i.e. not all designed features of the system are implemented.

For example, the number 0.3.4, says that the system is being developed and has version 0.3. Furthermore, stabilization level is 4.

The visualization subsystem is distributed both in conjunction with the SCADA system, and separately. In any case, for convenient distribution, the visualization subsystem should be packaged in a distribution kit. The name of the distribution should include the name of the subsystem and its version.

To prevent unreasonable claims, in case of damage to the distribution package, the method of packaging in the distribution package should include checking the integrity of the distribution package.

Distributions can be recorded on any medium or placed on the Internet.

* 1. Requirement for transportation and storage

Distributions can be stored both on physical carrier and on information resources on the Internet.

In the case of storage of the distribution kit on physical carrier, the following requirements are established for the storage location: it must be dry, exclude direct sunlight and direct exposure to electromagnetic fields. Shelf life is determined by the type of carrier.

Physical carrier can be transported in any way excluding mechanical, thermal and electromagnetic effects.

Distributions posted on Internet information resources can be copied in any way, possibly with subsequent recording to physical carrier.

1. Requirements for software and engineering documentation

The documentation for SCADA systems and technical equipment should include:

1) terms of reference;

2) technical descriptions of systems (passports).

3) Technical documentation of wiring diagrams.

4) Technical documentation of electromechanical construction drawings and installation documentation.

5) Factory and installation equipment warranties.

6) Product specifications and overall devices.

7) a working draft, consisting of:

• specification;

• program description;

• program text;

• programmer's manual;

• Backup software for all levels of an ICS systems and SCADA systems. (installation copies or finished media with working programs.)