**Delivery and installation of flow measurement system on Zhinvali HPP**

**Zhinvali HPP General Data**

The Zhinvali HPP consists of a 520 mio m3 reservoir retained by an embankment dam on the Aragvi

River.

Head 170 m water head and a 130 MW power plant. The scheme was commissioned in 1985.

 The main characteristics of the project are the following :

Hydrology

* Average river flow at intake 43.8 m3/s

Dam

* Type Earth dam
* Structure With central clayey core
* Material Gravels and clay
* Foundation soil Conglomerate

Reservoir

* Function Seasonal water storage
* Normal water level 810 masl
* Minimum operational level 770 masl

Spillway

* Type Ungated overflow spillway, open channel
* Location Left bank
* Elevation 810 masl
* Length 600 m
* Design flood 1'240 m3/s

Bottom outlet

* Type Tower
* Number of openings 2 (5.0 x 5.0 m2)
* Elevation 762.8 masl
* Capacity 1'080 m3/s

Water intake

* Type Tower
* Capacity 115 m3/s
* Protection Two gates (service / maintenance)

Penstock

* Operation mode Pressurized
* Location low level
* Material Reinforced concrete and steel lining
* Length 648 m
* Diameter 5'500 - 5'300 mm

HPP

* Number of Units 4
* Type of turbines Francis (vertical)
* Total installed power P = 4 X 32.5 MW= 130 MW

Energy

* Annual production 430 GWh
* Transformers 2 x 220 MVA + 1 x 110 MWA
* Power line 110 kV, 220 kV

The specification calls for flow measurement systems for each turbine:

* Flow measurement systems for each Turbine penstock section
* Supplier must be presentrd price for delivery and installation duration for 2 set of equipments and for 4 set of equipments.
* Required accuracy of these flowmeter were defined by Zhinvali HPP / GWP with 1% Transducer mount shall be in accordance with the IEC60041 / ASME PTC 18

#  Technical datas

* Penstock diameter = 2.2m
* Valve fully open
* V = >0.5m/s
* Nominal pressure before the turbines: hydrostatic pressure, min - 13 bar
* Maximum pressure before the turbines: hydrostatic pressure, max - 17 bar

# Penstock Flow Measurement

## Scope of supply

* Flow measurement in the penstock
* Gross head 170 m.
* Discharge measurement 0-50 m3/s
* Control unit with integrated turbine efficiency monitoring

## Flow Measurement Methode

* The flow measurement method (like Ultrasonic transit time) and according IEC60041/ ASME PTC18 for turbine efficiency testing and monitoring and shall provide a possible accuracy of 1 % on the measured flow (Q) value.
* The meter shall allow at least the calculation methods associated with the type of measurement arrangement in full pipelines under pressure

## Applicable Standards

* IEC-60041(1991) - Tests of hydraulic turbines, accumulation pumps and pump-turbines, to determine their hydraulic performance.
* ASME PTC-18 (2011) - Hydraulic turbines and pump-turbines. Performance test codes.

## Design

* The flow measurement system design shall be according IEC60041/ ASME PTC18 a.
* Protection cover system shall be designed for a waterproof application.

## Communication & Interfaces

* The flowmeter must be able to be integrated into the Plant Distributed Control System (SCADA) directly through IEC 60870-5-104 protocol.
* The flowmeter must be able to be programmed by web-interface / web-browser, no proprietary software is accepted.
* Flow data transfer technology must be Ethernet with at least 10/100 BaseT -, protocol TCP/IP
* Flowmeter must include WIFI 802.11a/b/g/n or newer/faster
* Flowmeter must include 3G/4G cellular modem option
* Flowmeter must be available to integrate signal in Siemens PLC
* Each Flowmeter must be having LCD panel (where must be showed flow different data) and it is mandatory to save minimum 1-year history for each of measurements and this data must have possibility to convert in excel file.

## Warrantee

Warranty must be minimum 2 years on all products and installations.

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| **Flowmeter - Technical Data Specification** |
| **1** | **General** |  | **Requirements** |
| 1.1 | Fluid Velocity Range |   | 0 m/s up to ±20 m/s (or more on request); bidirectional |
| 1.2 | Calculation of flow accordance |   | IEC-60041/ASME PTC18  |
| 1.3 | Flow data transfer technology |   | Ethernet port with at least 10/100 BaseT – TCP/IP |
| 1.4 | Transit Time |   | < 1ns |
| 1.5 | Minimum measuring range |   | 0-50 m3/s |
| 1.6 | User/parameterization interface |   | By web browser / no proprietary software accepted |
| **2** | **Communication interfaces and protocols** |  |  |
| 2.1 | Ethernet |   | Ethernet ports with at least 10/100BaseT |
| 2.2 | Wireless |   | WIFI 802.11a/b/g/n or newer/faster |
| 2.3 | Cellular |   | 3G/4G cellular modem option |
| 2.4 | Modbus RTU+RCP, Master+Slave |   | built in in the control unit (no external devices/interfaces accepted) |
| 2.5 | IEC 60870-5-104 |   | built in in the control unit (no external devices/interfaces accepted) |
| 2.6 | Security of all relevant external digital communication interfaces |   |  SSL/TLS 1.3 or newer |
| **3** | **Environmental conditions** |  |  |
| 3.1 | Ambient temperature |   | -20 … +70 °C |
| 3.2 | Relative Humidity |   | 5-95 % @ 25 °C |
| 3.3 | Installation height |   | up to 1000 masl |
| **4** | **Power supply** |  |  |
| 4.1 | Rated voltage | 24-48VDC / 90-260 VAC |
| **5** | **Analog and digital Signals (Outputs/Inputs)** |  |
| 5.1 | Analog Outputs | min. No of Analog outputs 4-20 mA | 4 (more as an option) |
| 5.2 |   | Resolution (bits) | 16 |
| 5.3 |   | Accuracy 25°C | ±0.1 %FS |
| 5.4 |   | Linearity | ≤ 0.04 % FS |
| 5.5 |   | Temperature drift | ≤ 70 ppm/K |
| 5.6 |   | Galvanic isolation | Full galvanic isolation |
| 5.7 |   | Overload protection | Integrated |
| 5.8 | Analog Inputs | min. No of Analog inputs 4-20 mA | 3 (more as an option) |
| 5.9 |   | Galvanic isolation | Full galvanic isolation |
| 5.10 | Digital Outputs | Galvanic isolation | Full galvanic isolation |
| 5.11 |   | min. No of digital outputs 4-20 mA | 9 digital output relays with configurable switched contacts(more as an option) |
| 5.12 |   | Output type | Relay with NO/NC changeover contact or solid-state with comparable electrical characteristics |
| 5.13 | Digital Inputs | Galvanic isolation | Optically Isolated |
| 5.14 |  | min. No of digital inputs 4-20 mA | 1 (more as an option) |
| **6** | **Flow Transducers** |  |  |
| 6.1 | Number of Transducers |   | Up to 20 path system according layout & needed |
| 6.2 | Galvanic isolation |   | Full galvanic isolation |
| 6.3 | Separation of transducers to flow meters |   | up to 300m |
| 6.4 | Degree of protection |   | IP 68 |
| 6.5 | Maximum pressure |   | at least up to 80bar |
| 6.6 | Probe frequency |   | 1 MHz |
| 6.7 | Transducer Material |   | Stainless steel 316L  |
| 6.8 | Water temperature range |   |  -30 °C to +70 °C  |
| 6.9 | Relative humidity range |   | 100% |
| 6.10 | Type/Way of installation |   | Mounting from inside or outside |