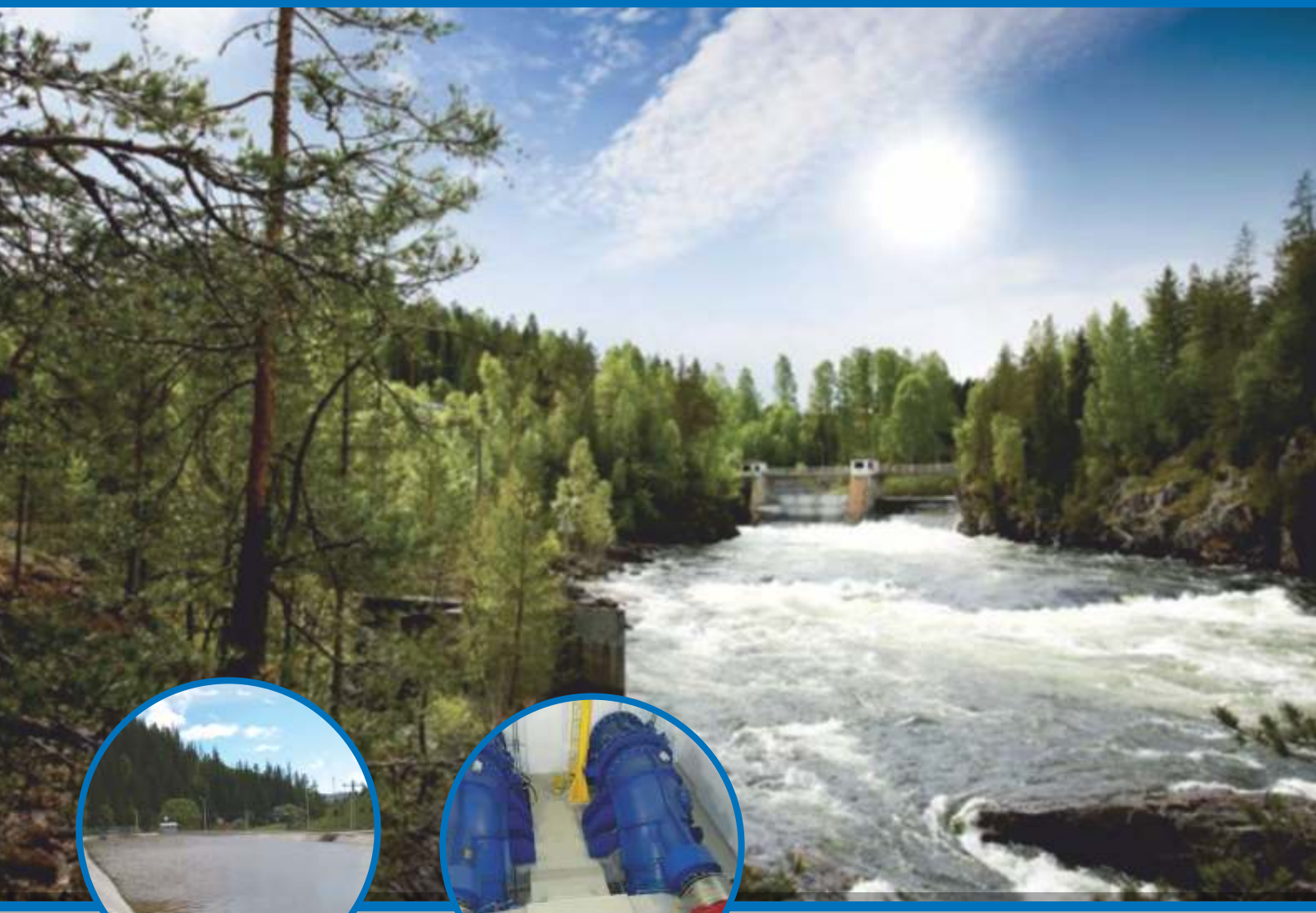




## EXPLOITATION OF THE HYDROPOWER POTENTIAL OF SUCEAVA RIVER BASIN

# CONTENTS

Portfolio of small hydroelectric power plants (SHPPs)

Hydropower development design for Suceava river

SHPPs main technical data

Modernization and refurbishment of SHPPs Ehrește, Brodina 1, Sadău, Putna, Bilca 1, Bilca 2, Bilca 3 and Țibeni

Exploitation of full hydropower potential of Brodina river by developing new SHPPs: Brodina de Jos and Brodina 2

The Quality management system

Investments made during the period 2008 - 2013

Technical contribution of ELECTROMAGNETICA to the SHPPs modernization and refurbishment investment programme

- 10 SHPPs located in Suceava river basin, respectively:  
SHPP Ehrește, SHPP Brodina 1, SHPP Brodina de Jos, SHPP Brodina 2,  
SHPP Sadău, SHPP Bilca 1, SHPP Bilca 2, SHPP Bilca 3, SHPP Putna,  
SHPP Țibeni.
- 8 SHPPs modernized and refurbishment during the period 2008-2013
- 2 new SHPPs: Brodina de Jos – commissioned 2010  
Brodina 2 – commissioned 2011
- Licensed by ANRE as electricity producer - 2007  
[Romanian Regulatory Authority for Energy]

**LEGENDA**

|  |                              |  |                 |
|--|------------------------------|--|-----------------|
|  | Râu                          |  | Linie electrică |
|  | Captare apă                  |  | Oraj            |
|  | Aducătoare (conductă forată) |  | Comună          |
|  | Aziuvară (pantă de beton)    |  | Sală            |
|  | Baraj de retenție            |  | Depozit         |
|  | Construcție de hidropower    |  | Drum asfaltat   |
|  | Construcție                  |  | Drum neasfaltat |

## SHPPs main technical data

| SHPP type                 | SHPPs           | $P_i$<br>[kW] | H <sub>gross</sub><br>[m] | $Q_i$<br>[m <sup>3</sup> /s] | $E_m$<br>[MWh] |
|---------------------------|-----------------|---------------|---------------------------|------------------------------|----------------|
| High-head<br>power plants | Ehrește         | 600           | 80                        | 1,08                         | 1.590          |
|                           | Brodina1        | 650           | 58                        | 1,50                         | 1.680          |
|                           | Brodina de Jos* | 870           | 68                        | 1,70                         | 2.030          |
|                           | Brodina2*       | 990           | 61                        | 2,03                         | 2.290          |
|                           | Sadău           | 518           | 121                       | 0,60                         | 950            |
|                           | Putna           | 239           | 45                        | 0,75                         | 280            |
| Low-head<br>power plants  | Bilca 3         | 384           | 6,9                       | 11,40                        | 950            |
|                           | Bilca 2         | 450           | 7,1                       | 11,40                        | 800            |
|                           | Bilca 1         | 312           | 6,7                       | 8,20                         | 950            |
|                           | Țibeni          | 454           | 7,1                       | 8,20                         | 1.180          |
| <b>Total</b>              |                 | <b>5,467</b>  | <b>12.700</b>             |                              |                |

\* New power plants



Modernization and refurbishment  
of SHPPs Ehrește, Brodina 1,  
Sadău, Putna, Bilca 1, Bilca 2,  
Bilca 3 and Țibeni

# Objectives of the SHPPs modernization and refurbishment programme

- Fulfillment of contractual obligations towards Hidroelectrica
- Accreditation of the hydroelectric power plants in order to receive the green certificates initially according to GD443/2003 and subsequently in compliance with Law 220/2008
- Increasing the amount of produced energy by:
  - Increasing the availability of hydropower units and hydraulic structure
  - Use of equipment with optimal efficiency for each SHPPs
- Full automation of the SHPPs in order to reduce the operating costs
- Compliance with the obligations mentioned in the operating permits issued by the “Romanian Waters National Administration” [ANAR] and “National Environmental Protection Agency” [ANMP]
- Reserve flows, functional fish passes, ensuring protection and safety areas for hydropower systems and facilities
- Social aspects: reduction of the flooding situations in certain localities; protection of comunal roads, river training, construction of bridges and culverts, etc.

## Refurbishment concept

- Measurement and recalculation of the power plants' parameters: gross head, net head, installed flow rate, installed capacity;
- Installed flow rate by taking into account the duration curve, the carrying capacity of the feed pipe and the turbines' flow rate;
- Increase captured discharge by changing the constructive solutions of the water intakes;
- Restore and increase the volume of compensating reservoirs;
- Replacement of the existing turbines, wich are old and outdated, with new hydropower units;
- Full automation of the power plants and implementation of the SCADA command, control and data acquisition system for the operation without permanent staff on duty and the remote control of the power plants;
- Design and development of data communications systems, using modern technologies, for transmitting the necessary parameters of the SCADA system (water level in the compensating reservoir, equipment status, etc.);
- Redesign of some hydromechanical equipment that meet the environmental protection imposed by the laws in force (fish passes, discharge of reserve flows, discharge of high waters, bank protections, etc.).

# SHPP EHREȘTE

- Water intake
- Compensation reservoir
- Bank protections
- Power house
- Hydropower units
- Transformer substation
- Operating software interface
- Computer-assisted control facility (SCADA)
- Data communication and water intake video surveillance system

|               |                        |
|---------------|------------------------|
| Location:     | Brodina River          |
| $Q_i =$       | 1,08 m <sup>3</sup> /s |
| $H_{gross} =$ | 80 m                   |
| $P_i =$       | 600 kW                 |
| $E_m =$       | 1.590 MWh/year         |

**SHPP EHREȘTE - INVESTMENTS MADE IN 2008 and 2009**

## DISCHARGED SILL AND WATER INTAKE

**Before modernization**

- Type – Tyroleses water intake

**After modernization**

- Type – lateral water intake

## COMPENSATION RESERVOIR

**Before modernization**

- advanced state of deterioration
- reservoir silting over 50% of the storage capacity

**After modernization**

- compensation reservoir with a volume of about 10.000 m<sup>3</sup>
- thus, due to the water stock, it allows the operation of power plants in drought conditions also, in all-or-nothing regime;
- bottom discharge system

**SHPP EHREȘTE - INVESTMENTS MADE IN 2008 and 2009**

**The hydro-technical knot Ehreste serves 4 SHPPs  
in the Brodina river hydropower development**



**POWER PLANT HOUSE**



**Before modernization**



**After modernization**

**SHPP EHREȘTE - INVESTMENTS MADE IN 2008 and 2009****HYDROPOWER UNITS****Before refurbishment**

Francis turbine and asynchronous generator

**After refurbishment**

Banki turbine and synchronous generator

- It operates in "line stream"
- High efficiency (86%) on the whole range of flow between 17 % and 100%
- Low volume of maintenance works
- Easy accessibility to changing components and subassemblies
- Equipped with two water inlet chambers (1/3 and 2/3) for variable flows

**TRANSFORMER SUBSTATION****Before refurbishment**

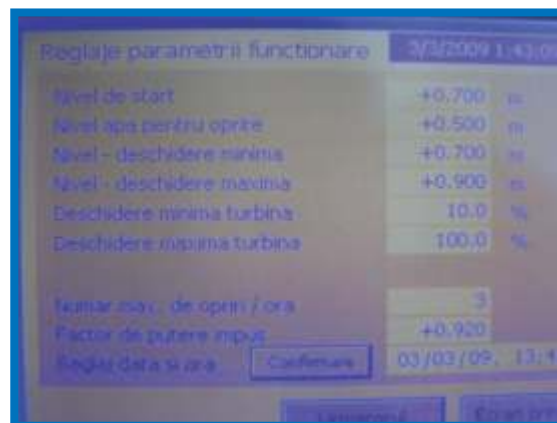
The transformer substation includes a TTU transformer booster from 04 to 20 KV with power of 1000 KVA and a medium voltage cell with the corresponding protection

This transformer substation connects to the national power system, as it is connected to the medium voltage line of 20KV of the local distribution operator E.ON Moldova.

**After refurbishment**

## SHPP EHREȘTE - INVESTMENTS MADE IN 2008 and 2009

## OPERATING SOFTWARE INTERFACE



The TOUCHSCREEN control panel of the power plant allows the real-time visualization of all the working parameters and also the visualization and control of the alarm operating modes and display modes.

**Main screen****Values**

- Active power
- Generator speed
- Water level in the reservoir

**Operating mode**

- Automatic – off
- Automatic – on
- Manual
- Service

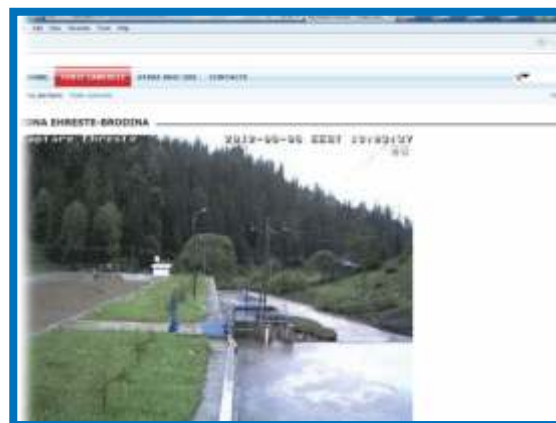
**Status**

- Stop
- Off
- Switching on
- Operating

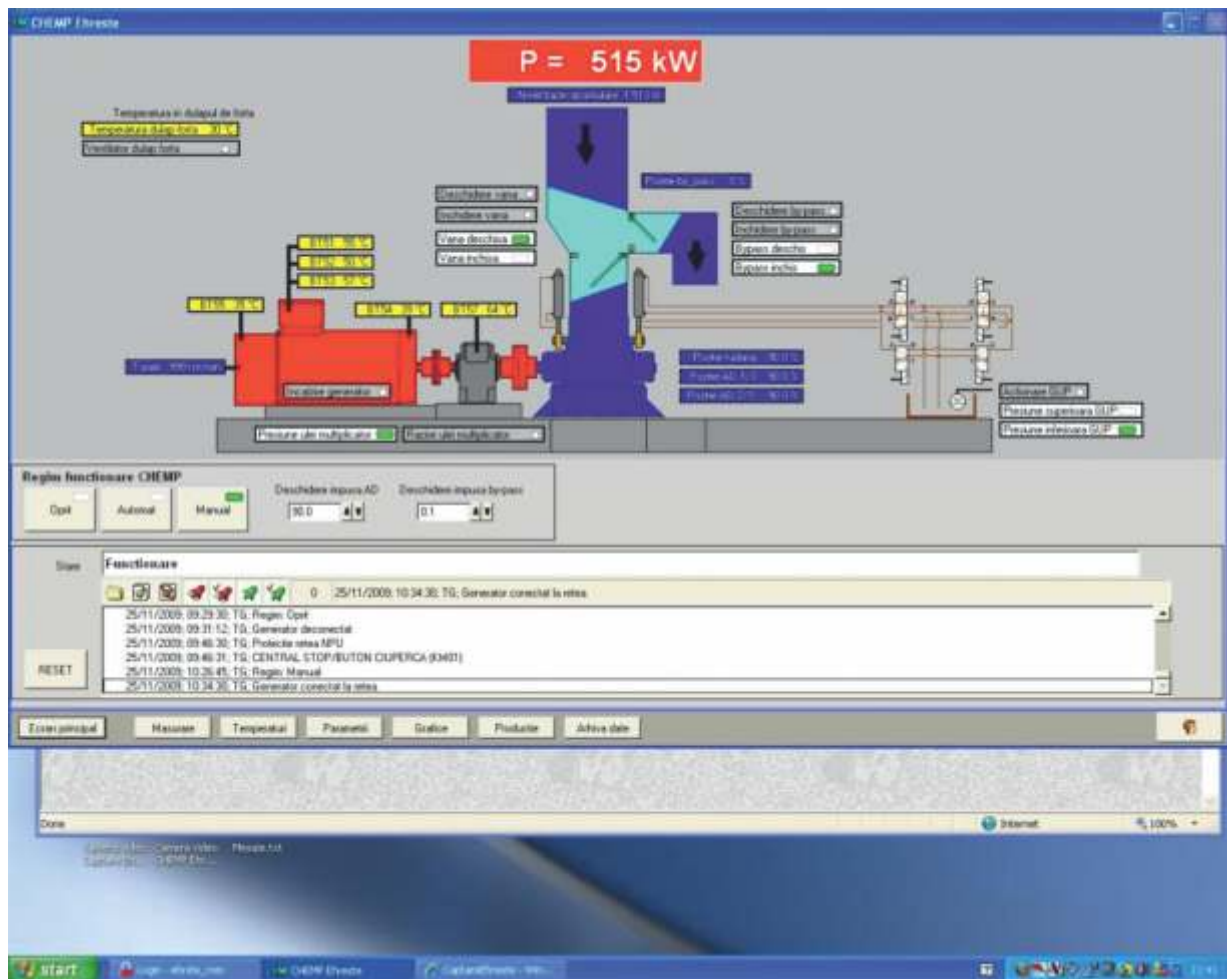
**Keys for the secondary screens**

- Value measurement
- Temperature measurement
- Temperature adjustment
- Operating parameters adjustment
- Failures, Events log
- Regime modification screen

## VSAT COMMUNICATION AND WATER INTAKE VIDEO MONITORING SYSTEM



## SHPP EHREȘTE - INVESTMENTS MADE IN 2008 and 2009

COMPUTER ASSISTED CONTROL FACILITY  
- SCADA

The access to the power plant command and control system is based on a password, at two security levels:

- the first level, the operator's level, allows the control of the power plant operating regimes and the visualization of all parameters
- the second level, the dispatcher's level - allows the control, visualization and modification of all operating parameters.

# SHPP BRODINA 1

- Water intake
- Compensation reservoir
- Bank protections
- Transformer substation
- Power house
- Hydropower units
- Operating software interface
- Computer-assisted control facility (SCADA)
- Data communication and water intake video surveillance system

Location: Brodina River

$Q_i = 1,50 \text{ m}^3/\text{s}$

$H_{\text{gross}} = 58 \text{ m}$

$P_i = 650 \text{ kW}$

$E_m = 1.680 \text{ MWh/year}$

**SHPP BRODINA 1 - INVESTMENTS MADE IN 2008 and 2009**

## WATER INTAKE

**Before modernization**

Type – Tyroleses water intake

**After modernization**

Type – lateral water intake

For taking over the water flow, resulting from the hydrographical basin difference between the Ehrește water intake and the Ehrește power plant, for the downstream Brodina 1 power plant, was designed a new water sill with lateral water intake reservoir

## COMPENSATION RESERVOIR

**Before modernization****After modernization**

The water collected by the Brodina 1 water intake, together with the water used by the upstream Ehrește power plant, is taken over in a second compensation reservoir, having the same capacity of 10,000 m<sup>3</sup>, thus doubling the water stock available for the other two power plants downstream.

In case of unavailability of the Ehrește power plant, the compensation reservoir continues to be supplied with water by means of a by-pass pipe with a diameter of 600 mm and an electrically operated plunger valve.

**SHPP BRODINA 1 - INVESTMENTS MADE IN 2008 and 2009**

## HYDROPOWER UNITS



### **Before refurbishment**

Francis turbine and asynchronous generator



### **After refurbishment**

Banki turbine and synchronous generator

# SHPP SADĂU

- Discharge sill
- Water intake
- Bank protections and groins
- Sand-clearing basin
- Compensation reservoir
- Feed pipe
- Power house
- Hydropower units
- Computer-assisted control facility (SCADA)
- Communication and monitoring system

Location: Sadău River

$Q_i = 0,60 \text{ m}^3/\text{s}$

$H_{\text{gross}} = 121 \text{ m}$

$P_i = 518 \text{ kW}$

$E_m = 950 \text{ MWh/year}$

**SHPP SADĂU - INVESTMENTS MADE IN 2011 and 2012**

**CAPTURE ZONE**



**Before modernization**



**After modernization**

**COMPENSATION RESERVOIR**



**Before modernization**



**After modernization**

**SHPP SADĂU - INVESTMENTS MADE IN 2011 and 2012****WASHOUT GATE AUTOMATION****AUMA electric drive unit****Knife gate valve****Automation cabinet****Operating interface**

**SHPP SADĂU - INVESTMENTS MADE IN 2011 and 2012**

**POWER PLANT BUILDING**



**Before modernization**



**After modernization**

**HYDROPOWER UNIT**



**Before modernization**

Francis turbine and asynchronous generator



**After modernization**

Banki turbine and synchronous generator

# SHPP PUTNA

- Discharge sill
- Water intake
- Bank protections and groins
- Sand-clearing basin
- Compensation reservoir
- Feed pipe
- Power plant building
- Hydropower units
- SCADA
- Communication and monitoring system

Location: Putna River

$Q_i = 0,75 \text{ m}^3/\text{s}$

$H_{\text{gross}} = 45 \text{ m}$

$P_i = 239 \text{ kW}$

$E_m = 280 \text{ MWh/year}$

**SHPP PUTNA - INVESTMENTS MADE IN 2012 and 2013**

**WATER INTAKE SILL**



**Before modernization**



**After modernization**

**COMPENSATION RESERVOIR**



**Before modernization**



**After modernization**

Before the refurbishment, the compensation reservoir was in an advanced state of degradation and it was silted over 50%.

**SHPP PUTNA - INVESTMENTS MADE IN 2012 and 2013****POWER PLANT BUILDING****Before modernization****After modernization****HYDROPOWER UNITS****Before modernization**

Francis turbine and  
asynchronous generator

**After modernization**

Banki turbine and synchronous generator

**SHPP PUTNA - INVESTMENTS MADE IN 2012 and 2013**

**CONTROL CABINETS**



**Before modernization**



**After modernization**

# SHPP BILCA 1

- Water delivery canal
- Compensation reservoir
- Overflow spillway
- Power plant building
- Hydropower units
- Automation and power cabinets
- Communication and monitoring system
- SCADA

Location: Suceava River

$Q_i = 8,20 \text{ m}^3/\text{s}$

$H_{\text{gross}} = 6,7 \text{ m}$

$P_i = 312 \text{ kW}$

$E_m = 950 \text{ MWh/year}$

**SHPP BILCA 1 - INVESTMENTS MADE IN 2008 and 2009**

## COMPENSATION RESERVOIR



**After modernization**



**After modernization**

- Compensation reservoir with the capacity of about 3000 cbm; equipped with bottom discharge;
- Trapezoidal section, slopes' gradient of 1.5

## HYDROMECHANICAL EQUIPMENT LOADING ANTECHAMBER



**After modernization**



**After modernization**

**SHPP BILCA 1 - INVESTMENTS MADE IN 2013****HYDROPOWER UNITS****Before modernization****After modernization**

- The two hydropower units equipped with EOS 1100 turbines were refurbished
- The hydropower units were fully automated

# SHPP BILCA 2

- Water delivery canal
- Compensation reservoir
- Overflow spillway
- Power plant building
- Hydropower units
- Automation and power cabinets
- Communication and monitoring system
- SCADA

Location: Suceava River

$Q_i = 11,40 \text{ m}^3/\text{s}$

$H_{\text{gross}} = 7,1 \text{ m}$

$P_i = 450 \text{ kW}$

$E_m = 800 \text{ MWh/year}$

**SHPP BILCA 2 - INVESTMENTS MADE IN 2013****COMPENSATION RESERVOIR****Before modernization****After modernization**

- Compensation reservoir with the capacity of about 3000 cbm; equipped with bottom discharge;
- Trapezoidal section, slopes' inclination of 1.5

**POWER PLANT BUILDING****Before modernization****After modernization**

## SHPP BILCA 2 - INVESTMENTS MADE IN 2013

### HYDROPOWER UNITS



**Before modernization**

- The three hydropower units equipped with EOS 1100 turbines were refurbished
- The hydropower units were fully automated



**After modernization**

### AUTOMATION CABINETS



**Before modernization**



**After modernization**

# SHPP BILCA 3

- Discharge sill
- Water intake
- Bank protection and groins
- Water delivery canal
- Compensation reservoir
- Power plant building
- Stilling reservoir
- Telemetering system
- Communication and monitoring system
- SCADA

Location: Suceava River

$Q_i = 11,40 \text{ m}^3/\text{s}$

$H_{\text{gross}} = 6,7 \text{ m}$

$P_i = 384 \text{ kW}$

$E_m = 950 \text{ MWh/year}$

**SHPP BILCA 3 - INVESTMENTS MADE IN 2011**

**CAPTURE ZONE AND ANTECHAMBER**



**Before modernization**

- Redesign and modification of the loading antechamber, for reducing the hydraulic losses and for improving the water flow regime;
- The trashrack zone was modified.



**After modernization**

**COMPENSATION RESERVOIR**



**Before modernization**



**After modernization**

**SHPP BILCA 3 - INVESTMENTS MADE IN 2011****POWER PLANT BUILDING****Before modernization****After modernization****GSM COMMUNICATIONS AND VIDEO MONITORING SYSTEM****Hydro-technical knot for 3 SHPPs****Discharge sill****Water intake - Sand-clearing basin****Compensation reservoir**

## SHPP BILCA 3 - INVESTMENTS MADE IN 2011

### HYDROPOWER UNITS

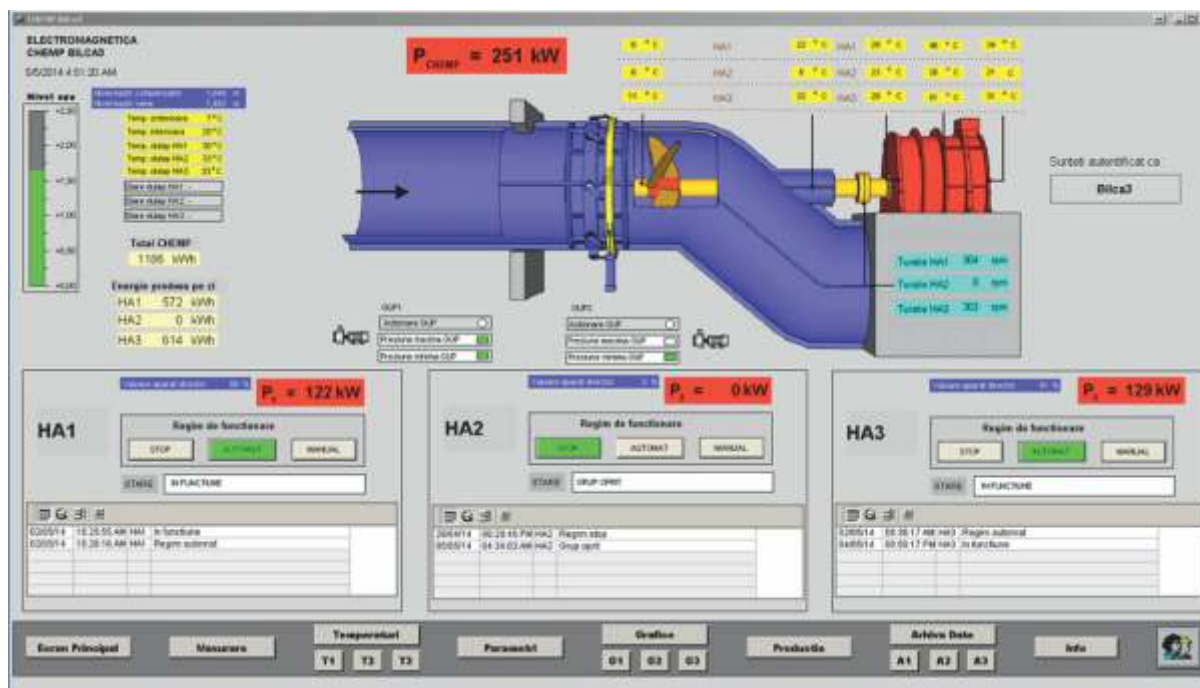


Before modernization



After modernization

### SCADA SYSTEM



- Integrated SCADA system for the 3 hydropower units

# SHPP ȚIBENI

- Discharge sill
- Water intake
- Bank protection and groins
- Water delivery canal
- Compensation reservoir
- Power plant building
- Hydropower units
- Automation cabinets
- Communication and monitoring system
- Operating software interface

Location: Suceava River

$Q_i = 8,20 \text{ m}^3/\text{s}$

$H_{\text{gross}} = 7,1 \text{ m}$

$P_i = 454 \text{ kW}$

$E_m = 1.180 \text{ MWh/year}$

**SHPP ȚIBENI - INVESTMENTS MADE IN 2010**

**DISCHARGE SILL AND WATER INTAKE**



**Before modernization**



**After modernization**

Sill lenght 80 m

**WATER INTAKE HYDRO-MECHANICAL  
EQUIPMENT**



**After modernization**



**After modernization**

- Redesign of the trashrack zone and move of trashrack from the Sand-clearing basin area in the front of the lateral water intake - on the purge stream.
- Much easier access to cleaning the trashrack in the operating activity.

**SHPP ȚIBENI - INVESTMENTS MADE IN 2010****WATER DELIVERY CANAL****Before modernization**

- Concrete open canal with longitudinal gradient of 1.7 %
- Trapezoidal section, slopes' gradient of 1.5
- Length of 2.3 Km

**After modernization****SPILLWAY****Before modernization****After modernization**

## SHPP ȚIBENI - INVESTMENTS MADE IN 2010 and 2013

### POWER PLANT BUILDING



**Before modernization**



**After modernization**

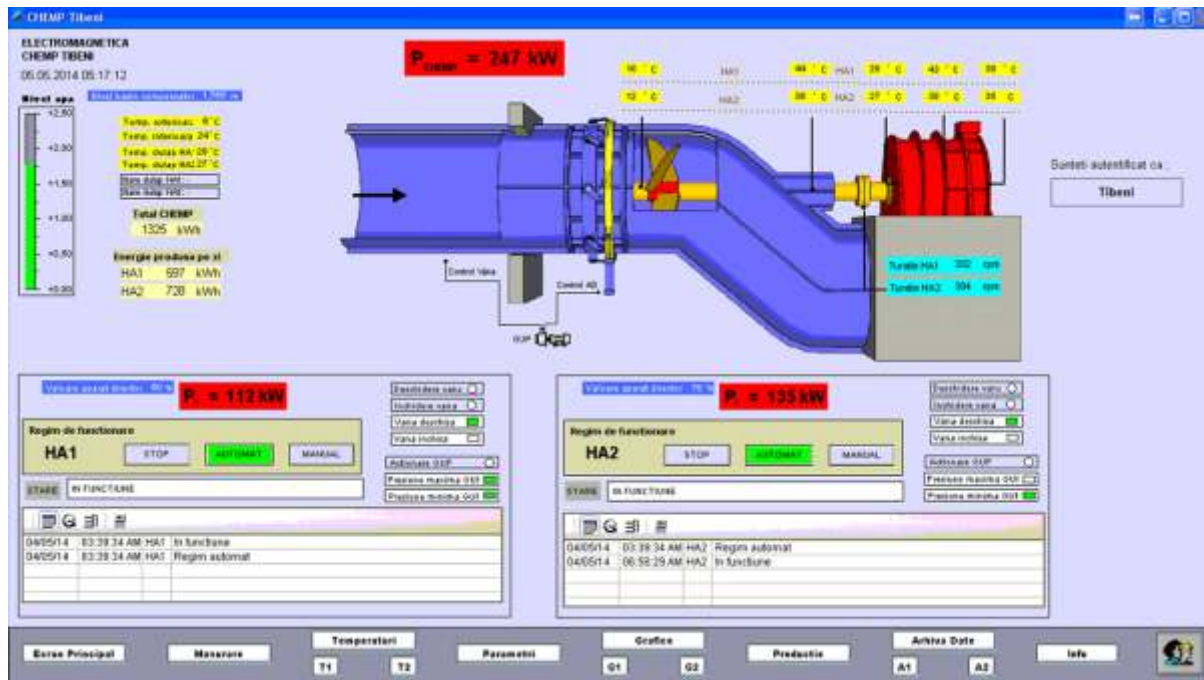
### HYDROPOWER UNITS



**After modernization**

- Modification of the sealing system for the turbine upstream and downstream bearings
  - Mechanical sealing - PTFE containing added graphite
- Replacement of the actuation system of the guide vane and of the counterweight system
- Replacement of bearings with others that provide a service period of over 50.000 hours
- Equipping the hydropower units with measurement elements of the working and protection parameters:
  - Temperature sensors on the upstream and downstream bearings
  - Sensor for guided vane blades rotation
  - Sensor for limiting the guided vane's stroke
  - Speed reading sensor

## SHPP ȚIBENI - INVESTMENTS MADE IN 2010 and 2013

SCADA SYSTEM  
DESIGNED AND EXECUTED  
BY ELECTROMAGNETICA

## Exploitation of the hydro-power potential of Brodina river by developing new SHPPs Brodina de Jos and Brodina 2

- In parallel with the modernization and refurbishing program, ELECTROMAGNETICA also built two new SHPPs;
- The promoted concept was that of a cascade power plants system as distributed units of electricity generation, constructively articulated by means of a main hydraulic line, consisting of upstream waterways of over 24 Km and that operates the hydropower units by means of a automatic and remote control unitary system;
- The best method to improve the medium-term economic and financial indicators of the development as a whole is to define a full development scheme of the basin, that efficiently solves the ancillary equipment technical problems, integrating the existing objectives with new ones in an unitary system.



# SHPP BRODINA DE JOS

Commissioned in September 2010

- Tyroleses water intake
- Loading chamber
- Feed pipe
- Bank protections
- Power plant building
- Turbinated water discharge
- Hydropower units
- Transformer substation
- Automatization
- Communication and video minitoring
- Access bridge

Location: Brodina River

$Q_i = 1,70 \text{ m}^3/\text{s}$

$H_{\text{gross}} = 68 \text{ m}$

$P_i = 870 \text{ kW}$

$E_m = 2,030 \text{ MWh/year}$

**SHPP BRODINA DE JOS - INVESTMENTS MADE IN 2009 and 2010**

## HYDROPOWER UNITS



- For taking over the water flow rate, resulting from the basin difference between the Ehrește SHPP and the Brodina 1 SHPP, an intake sill was provided with Tyroleses water intake and loading chamber
- The loading chamber also takes over the water used by SHPP Brodina 1;
- The discharged field of the sill includes a servitude field equipped with a fish pass;
- The lower water of the discharge sill is equipped with an energy disperser consisting of a fixed rear apron and a mobile one.

## FEED PIPE



### Modernization works

- The available water is taken over by an influent conduit made of PAFSIN
- Conduit diameter: 1300 mm
- Conduit section length: 6.1 km
- The conduit section is equipped with manholes for inspecting the conduit



### Modernization works

**SHPP BRODINA DE JOS - INVESTMENTS MADE IN 2009 and 2010****POWER PLANT  
BUILDING****TURBINE****HYDROPOWER UNITS****TRANSFORMER  
SUBSTATION AND MEDIUM  
VOLTAGE CELL**

# SHPP BRODINA 2

POS CCE Axis 4 Grant

Commissioned in April 2011

- Main water intake
- Secondary water intake - Tyroleses intake
- Feed pipe
- Bank protection
- Power plant building
- Turbinated water discharge
- Hydropower units
- Transformer substation
- Automatization
- Communication and video monitoring
- Access bridge

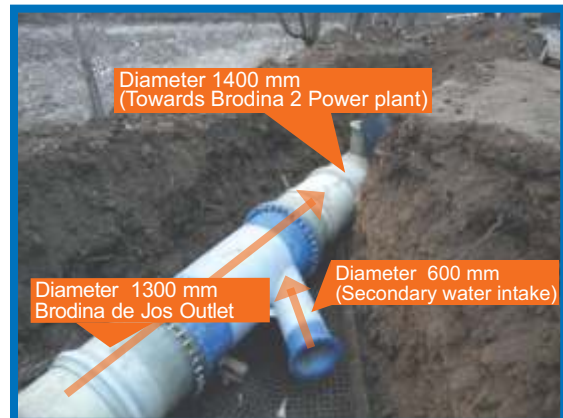
Location: Brodina River

$Q_i = 2,03 \text{ m}^3/\text{s}$

$H_{\text{gross}} = 68 \text{ m}$

$P_i = 990 \text{ kW}$

$E_m = 2.000 \text{ MWh/year}$

**SHPP BRODINA 2 - INVESTMENTS MADE IN 2010 and 2011****SECONDARY WATER INTAKE -  
TYROLESEES INTAKE****JUNCTION BETWEEN THE  
MAIN UPSTREAM WATERWAY  
AND THE SECONDARY  
UPSTREAM WATERWAY****BANK PROTECTION**

The banks were protected with concrete walls and gabion walls over a length of over 400 m

## SHEPP BRODINA 2 - INVESTMENTS MADE IN 2010 and 2011

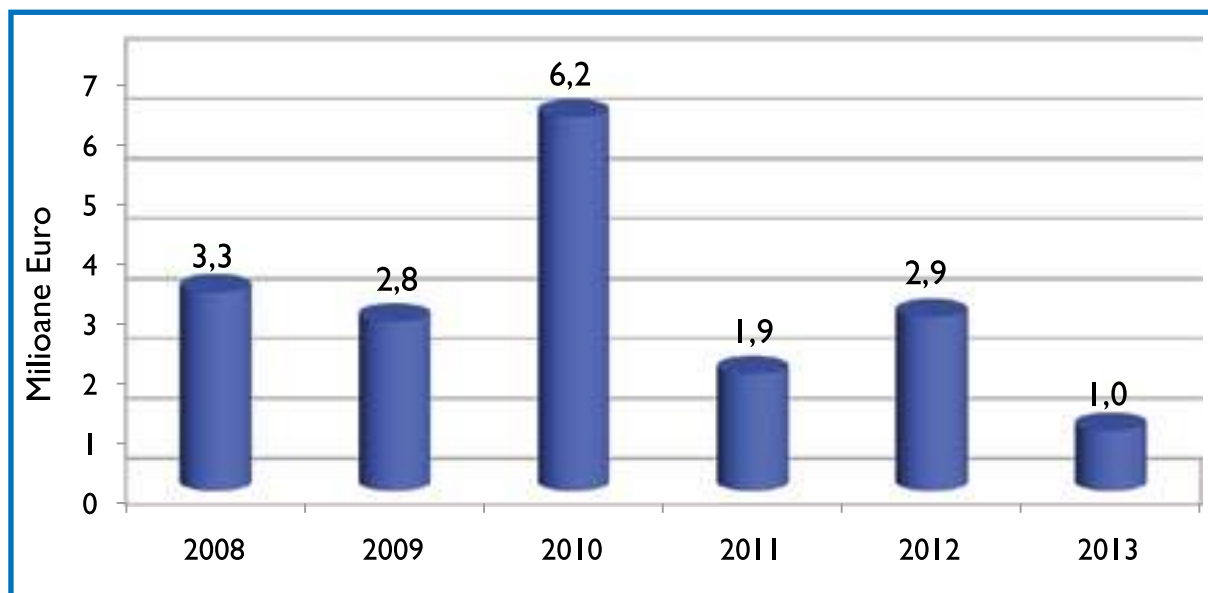
## POWER PLANT BUILDING



## Quality management system

- ELECTROMAGNETICA has developed and implemented over the past few years a quality assurance system in the Rădăuți Hydroelectric Power Plant, starting from the laws in force, the internal quality assurance system and last but not least from the experience acquired in this field over the past 5 years
- This has resulted in over 50 operational procedures that include almost all fields such as:
  - Exploitation and operation of power plants, including the exploitation regulations
    - Automatic, manual, SCADA, failure warnings
    - Auxiliary equipment exploitation including high floods regime, winter regime, drought regime
  - Maintenance of hydropower units, hydro-mechanical and electrical facilities
    - current maintenance works
    - preventive maintenance works on 4 levels (LN1...LN4)
  - Intervention system for special situations: high floods, failures, burglary, fires, work accidents, etc.
  - Personnel security in exploitation activity and interventions
  - Heritage safeguard conservation
  - Information and computer system: reports, their hierarchy, software upgrade.
- Some other procedures shall be completed, such as: exploitation monitoring and conduct of the hydro-power objectives, renewal of approvals in the field of power plants operation (OGA), environment, labour protection, etc.

## Investments made during the period 2008 - 2013



## Technical contribution of S.C. ELECTROMAGNETICA S.A. to the investment program for the modernization and refurbishing of SHPPs.

The company's experience and know-how in the field of design and manufacture of distribution and measuring equipment of electricity in low voltage grid, such as:

- Single-phase electronic meters
- General switchboards, distributing boxes, transformer substation boxes, single-phase and three-phase measurement and protection blocks, distribution and metering recesses, overvoltage protection devices, etc.
- Electricity telereading and metering centralized system for household and industrial consumers - ENERGSys gave rise to the development of new software equipment and products, with application for SHPPs modernization and refurbishing program.

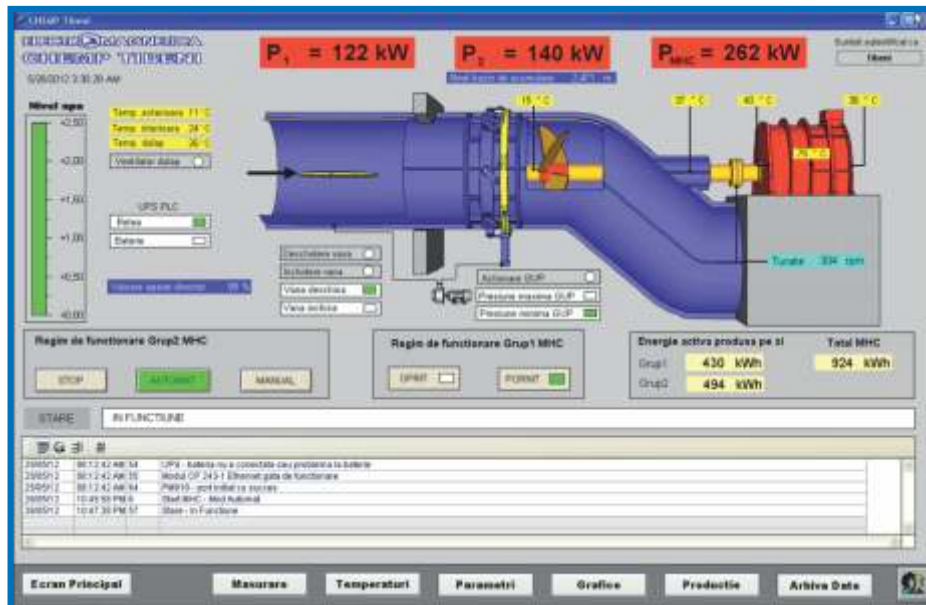
- Full automation for hydropower units equipped with EOS 1100 turbines:
  - Power cabinet
  - Automation cabinet
  - Cabinet for power factor compensation
  - Design and execution of SCADA
- System SCADA web
- Design and execution of video monitoring systems
- Design and execution of communication systems
- Design and execution of indoor and outdoor electrical wirings

## POWER AND AUTOMATION CABINETS



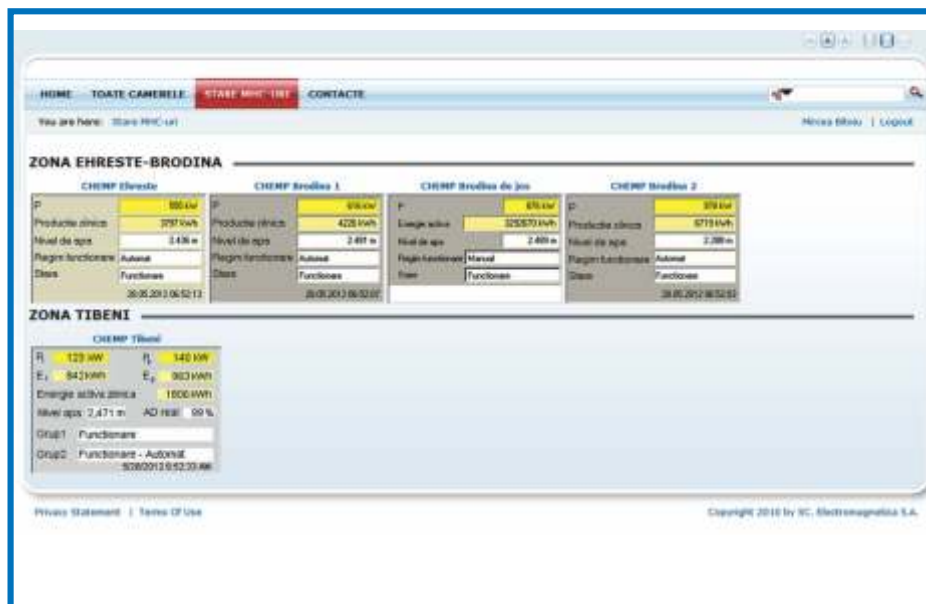
# Full automation for hydropower units

## COMPUTER ASSISTED CONTROL SYSTEM (SCADA)



Ecran principal

## COMPUTER ASSISTED CONTROL SYSTEM (SCADA)



- The small hydropower plants can also be monitored via a WEB interface, accessible from any Internet connection point.
- Real-time information regarding the operating mode, condition, water level, etc.

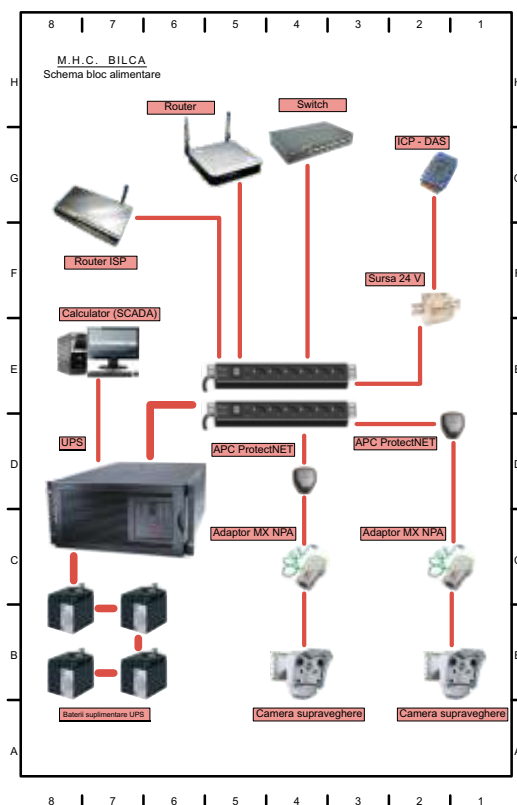
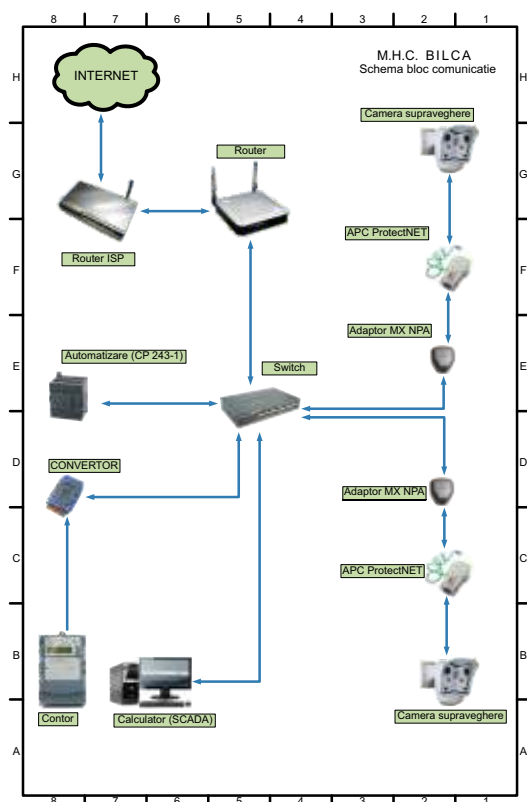
## Design and execution of video monitoring systems

- Centralized video monitoring in web browser with secure access
- Individual zoom facilities, details analysis, horizontal reorientation of cameras



## Design and execution of communication systems

- The communication and data transmission system allows operating the SHPPs in fully automated mode and also the remote monitoring and control (dispatch centre).
- The system involves the existence of a LAN internal network and also the connection to the equipment in the power plant via Internet, ensures the possibility to communicate via a voice channel with the power plant service personnel and the video monitoring of the power plant site, as well as the daily reading, respectively at the end of the month, of the load curve and of the energy indices
- The Internet connection for data transmission to the dispatch centre uses various technologies, depending on the solutions available at each location. The Internet connection solution using the GSM communication was generally applied. In the isolated locations where there is no GSM coverage, the VSAT technology was used.



## Design and execution of indoor and outdoor electrical wirings



ELECTROMAGNETICA S.A. has designed and executed the indoor and outdoor electrical wirings for all the 10 SHPPs.

## Environmental conditions



- The activity of electricity generation by means of small hydroelectric power plants is considered to be electricity generated from renewable sources. The Romanian legislation and specially the European legislation supports the electricity generation from renewable sources and contributes to the development of new electricity generation capacities of this type (European funds, green certificates, etc.)
  - The water intake sills are provided with specific constructions allowing the permanent transit of the reserve flow in compliance with the operating permits. Wooden intake sills were also constructed, to reduce their impact on the environment
  - Several concrete walls and gabion walls were, constructed ensuring the protection against high floods, both for the ancillary equipment within the development (intake sills, influent conduits) and for the roads (the power plants on Brodinei, Sadău river valley)
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- For achieving the new objectives (SHPP Brodina de Jos and SHPP Brodina 2) no solutions of conduit lying in the riverbed were adopted
  - Stream regulation works were performed upstream the intake sills (Ehrește, Sadău) and in the bridges area (Brodina de Jos and Brodina 2)
  - The hydro-aggregates used are fully automated and thus the exploitation is performed at the highest safety levels from the environmental protection point of view:
    - Under the hydro-aggregates supply contract, Electromagnetica imposed its suppliers to comply with all the environmental conditions within the European Union
    - The risk of non-compliant exploitation from the point of view of the environmental factor is reduced both by the full automation of power plants and by the video monitoring system
    - For performing the maintenance works, several operational procedures were implemented. Such works are performed by specialized personnel, using modern equipment and devices to perform them
    - By means of the technical solution adopted, Electromagnetica tried to minimize the use of materials that can pollute (replacement of the oil lubrication systems with Vaseline lubrication systems in mechanical mode, etc.



266 - 268 Calea Rahovei, Bucharest - ROMANIA

Tel.: 0040 21 404 21 46; Fax: 0040 21 404 21 48

[www.electromagnetica.ro](http://www.electromagnetica.ro)