

## ENVIRONMENTAL DATABASES FOR IRON GATES HYDROPOWER STATIONS

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*The paper presents the structure and the performance of a new database needed for monitoring the environmental impact of the IRON GATES hydropower plants. The first part of the paper contains a short assessment of the environmental impact of the hydropower plants. The second part presents the database structure developed by a highly automatic data processing system, according to the European laws regarding the environmental protection. The database can be accessed by the power plants employees, but it is also world wide available by INTERNET. The informatics system is based on a L.A.M.P. structure (Linux, Apache, MySQL, PHP) including the following components: Linux operating system; Apache web server; RDBMS (Relational Database Management System) MySQL; Middleware (programming language) PHP. This structure allows the access to the information from a local dedicated server, or remotely, through the Internet, from a common web browser. The system will be managed and updated by the Iron Gates National Hydropower System, following the different requirements.*

**Keywords:** environmental monitoring, hydropower stations, database, web.

### 1. Introduction

Beyond the global positive effects regarding the natural environment, Iron Gates power plants have some negative effects as a result of bed silt reorientation and fish nests migration in hydro dam's area. In this term, the development of research based on environmental knowledge of hydroelectric projects can be highly useful to cut down some disruptive effects on the surrounding aquatic ecosystems. This field of expertise rise highly interesting issues, but also implements the obligation to environmental preservation by developing and implementing the solution for each problem. This paper presents the built and the implementation of a world wide web database as an assessment practical tool of the Iron Gates power plant impact on the natural environment; this new tool is also used as an active tracking system for all environmental data.

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## 2. Environmental impact on water settlements

### ⇒ **Pollution source:**

Production of the electric energy in the hydroelectric power plants is accompanied by environmental effects. The surface water pollution is a global major issue. Interrelationships between surface waters and others from different hydrosphere compartments is an additional aggravating factor. This kind of precipitation brings up another type of pollution into the atmosphere.

Pollution sources can be: *organized*, when the pollution comes after releasing substances through designated appliance, like sanitation discharge or industrial drain and *unorganized*, when pollution comes from an uncontrolled penetration into the waters.

Organized pollution sources are basically sewage waters and industrial residual waters. The sewage waters are bacteriological and chemical contaminated and they come mostly from indoor sanitation. In the industrial residual waste, the most important pollutants factors come from the mining waters and thermal pollution. The unorganized pollution sources can be casual like various discharges or accidental floods and other calamities. The accidental sources are rarely expected.

### ⇒ **Waters pollutant nature:**

Public knowledge about the water quality and pollution control process shows a certain diversity like in the advanced countries, which try to raise the water quality damaged in 1900 – 1950. The third world countries can't control the processes that produce all pollutant factors. Starting from their nature, the primary water pollutants can be classified into: pathogenic agents that result from viral, bacterial and parasite caused diseases; organically biodegradable compounds; nitrates compounds; salt or acids compounds; hard metals; organically micro pollutants.

### ⇒ **Water pollutant activity:**

Any water pollution has a direct or indirect effect through the flora and fauna or through long trophic chains on living organisms including humans.

Nitrates pollution comes especially from agriculture chemistry but also from natural sources like rock material and burned vegetation ashes. They have a toxic effect, directly or through other compounds, on all living organisms through a lot of mechanisms. The removal of this pollutant from potable water is a very complex and expensive process. The nitrate compounds have an eutrophication water-bearing contamination effect and can endanger human health.

### ⇒ **Surface waters self-purification process:**

Up to a certain state, surface waters have a natural purifying capacity. The self-purification procedure is accomplished due to some physical processes (dilution, blending, diffusion, sedimentation, coagulation, and oxygen dissolution,

influenced by solar IR, UV radiation and water temperature), chemical processes (neutralization, oxidation, precipitation, absorption, photochemical decomposition), biological processes and biochemical processes. Self-purification is negatively affected by steady water flow, high or very low water temperature, and high toxic concentration.

⇒ **Impact on the water quality:**

The physical and chemical features of the lakes are deeply modified by any hydro power plant. Because of the density difference between water layers, pressure difference emerges and water stratification process appears. In low depth waters this process can be overlooked because of the homogenization that precedes the wind action. In deep waters this process is emphatically noticed due to three-layer stratification with different temperature.

The first layer is heated through the sun action and the heat supply provided by the river (epilimnion); the intermediate layer has a higher temperature gradient (metalimnion) and the inferior layer has a relative constant temperature of 4° C (hypolimnion). The density current and the lake water stratification have a direct affect on all physical, chemical and biological properties of lake water quality. Due to the lack of oxygen in the hypolimnion layer, anaerobic processes emerge and that generates ammonium and phosphor. Once with the temperature rising and the pollution increasing, the dissolved oxygen level is decreasing.

The monitoring of the water's biological quality is a tool for minimizing the effects of the hydropower plants on flora and fauna.

⇒ **Impact on the climate:**

In our country, accumulation lakes have a low influence, which is limited only to the local microclimate. Building of fog through evaporation over an accumulation lake depends on the air humidity level, the temperature difference between the upper water layer, atmospheric air and water salinity. Therefore the fog to emerge the water temperature is necessary to be higher than the air temperature and the air relative humidity to be greater than 90%; this kind of condition appears in late autumns. If the process emerges in an area where the wind speed is low, then the evaporated water standstill, and the humidity level is rising.

⇒ **Impact on the flora:**

Flora has a special role in keeping the ecological balance, through air and water oxygenation, insurance of living condition for animals, birds and fishes and last but not least keeping all beautiful sites.

Building accumulation lakes the aquatic conditions are radically changed, the river poor flora is replaced with rich pile flora. During exploitation period, the lake level variation emerges a destruction procedure of vegetation in working areas through flooding-drying process. Solving this issue involves knowledge of existent flora.

**⇒ Impact on the fauna:**

Large animals are affected by their eating-places disappearance, from the lake basin, by disappearance of usual passes and appearance of sharp riverbanks that bar their normal access to water.

Birds aren't too affected by the lake presence; they actually accomplish a colonization area because they can easily find great life and reproduction conditions.

The aquatically fauna is strongly affected by artificial water accumulation, flow rate, volume and surface of the water, temperature and oxygen content. Basely in a well thrifty lake the water surface and volume extension, follows an increase in quantity and proportion on fishes. Low oxygen level content, water standstill, rising temperature and pollution follows a drop in valuable fish species. A hydropower system is a hard to pass obstacle in the fish migration or food finding.

**3. LAMP structure (Linux, Apache, MySQL, PHP)**

MySQL is popular for web applications and acts as the database component of the LAMP, MAMP, and WAMP platforms (Linux/Mac/Windows-Apache-MySQL-PHP/Perl/Python), and for open-source bug tracking tools like. MySQL is a multithreaded, multi-user SQL database management system (DBMS) which has, according to MySQL AB, more than 10 million installations. The basic program runs as a server providing multiuser access to a number of databases. Its popularity for use with web application is closely tied to the popularity of PHP, which is often combined with MySQL. PHP and MySQL are essential components for running popular content management systems and blogging platforms.

The database containing information about the Iron Gates National Hydropower System impact on the environment was developed using MySQL server and covers the following data.

- In the central table named "p\_prelevare" are stored data concerning: exploitation areas like PdFI (Iron Gates I), PdFII (Iron Gates II) and other specific locations; data acquisition locations; person in charge for the data acquisition; comments.
- In the profile tables – ground, water, air data concerning: identity of pollutants; data acquisition areas; data acquisition timetable; person in charge for the data acquisition; comments.
- The waste table data is regarding: identified waste in different exploitation areas ("pf" waste); known waste due to H.G. 856 ("hg" waste); stored waste type with all afferent information and comments.

- In the legal interface table and other external factors are stored data regarding: legal profile information; environmental licensees; environmental agreements; letters of advice and other necessary documents for environmental management.

The database architecture contains tables as follows (Fig. 1): “acorduri\_de\_mediu”; “autorizatii\_de\_mediu\_ape”; “apa”; “avize\_vize”; “cerinte\_legale”; “deseuri”; “deseuri\_hg”; “deseuri\_pf”; “noxe\_auto”; “noxe\_diesel”; “p\_prelevare”; “sol”.

```
mysql> show tables;
+-----+
| Tables_in_mediu_pf |
+-----+
| acorduri_de_mediu  |
| apa                |
| autorizatii_de_mediu_ape |
| avize_vize         |
| cerinte_legale     |
| deseuri            |
| deseuri_hg         |
| deseuri_pf         |
| noxe_auto          |
| noxe_diesel        |
| p_prelevare        |
| sol                |
+-----+
12 rows in set (0.00 sec)
```

Fig. 1. Defined tables in the database structure.

Data table description are built as follows (Fig. 2):

Table „acorduri\_de\_mediu”, with: *nr* – ID number; *den\_doc* – document name; *nr\_doc* – document number; *data\_obt* – document’s initial validation date; *data\_val* – document’s last validation date; *obs* – comments.

```
mysql> describe acorduri_de_mediu;
+-----+-----+-----+-----+-----+-----+
| Field | Type          | Null | Key | Default          | Extra |
+-----+-----+-----+-----+-----+-----+
| nr     | int(11)       | NO   | MUL |                  |       |
| den_doc | varchar(254)  | NO   |     |                  |       |
| nr_doc | decimal(10,0) | NO   |     |                  |       |
| data_obt | timestamp     | YES  |     | CURRENT_TIMESTAMP |       |
| data_val | timestamp     | YES  |     | 0000-00-00 00:00:00 |       |
| obs    | varchar(254)  | YES  |     | NULL             |       |
+-----+-----+-----+-----+-----+-----+
6 rows in set (0.00 sec)
```

Fig. 2. Table: „acorduri\_de\_mediu”

Data inserted in the “deseuri\_hg” table due to HG no. 856 / 16.08.2002 regard the waste data processing. The database structure allows the monitoring and control of all waste categories that can appear in the Iron Gates National Hydropower System area.

Data inserted in the “deseuri\_hg” table answer to the purpose established in the H.G. no. 856 from 16.08.2002 agreement. This database will serve to the

Iron Gates National Hydropower System environmental monitoring and will be filled according to the user's necessities, suitable to the corresponding data.

#### 4. Web published user friendly interface module

The client application (where users can read and write into the database) was developed using PHP scripting method combined with the facilities provided by the MySQL database server; for graphic generation the gd2 module was used.

The software is build-up from the dynamic HTML generated features. This application is based on two different modules.

First module is developed with different PHP scripts that allow users to read data from the MySQL database.

The second module is known as "the administration area" because users can insert and modify data within the database (Figs 3-4). The administration area is protected for unauthorized access by dedicated passwords.

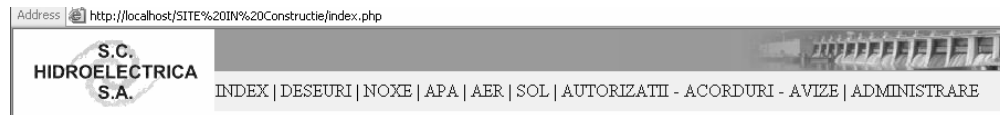


Fig. 3. Public area.

	<input type="checkbox"/>	An	Trim	Temp [°C]	Ph	Mts [mg/l]	Coccr [mg/l]	Cbo5 [mg/l]	Det sintetici [mg/l]	Obs	P lucr	P prel
APA	<input checked="" type="checkbox"/>	Sortat după: ID crescator										
AER	<input checked="" type="checkbox"/>	2006	1	10.5	1	2	2	2	1	-	PF 1	Amonte PF1
SOL	<input type="checkbox"/>	2006	2	11.777	2	3	2	2	0	-	PF 1	Amonte PF1
NOXE	<input type="checkbox"/>	2006	3	10	1	2	2	2	1	-	PF 1	Amonte PF1
DESEURI	<input type="checkbox"/>	2005	1	10	1	2	2	2	1	-	PF 1	Amonte PF1
DESEURI	<input type="checkbox"/>	2005	2	5	3	4	3	2	1	-	PF 1	Amonte PF1
LEGISLAȚIE	<input type="checkbox"/>	2005	3	11	2	3	2	2	0	-	PF 1	Amonte PF1
PARAMETRI INT.	<input type="checkbox"/>	2006	1	10	1	2	2	2	1	-	PF 2	Amonte PF2
	<input type="checkbox"/>	2006	2	11	2	3	2	2	0	-	PF 2	Amonte PF2
	<input type="checkbox"/>	2006	3	10	1	2	2	2	1	-	PF 2	Amonte PF2

Fig. 4. Restricted administration area.

The data extracted from the databases can be also visualized by graphs, as follows (Fig. 5).

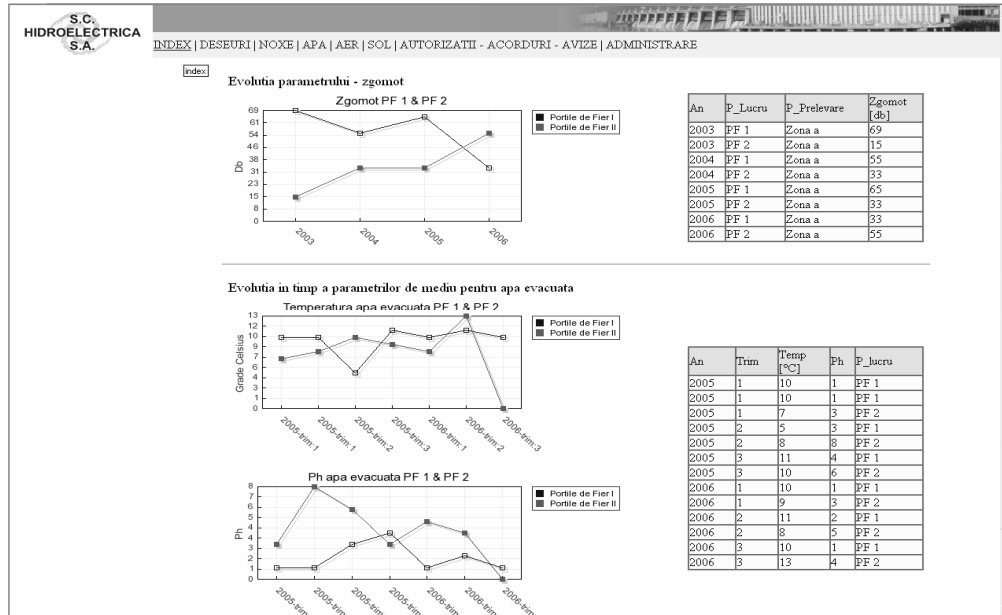


Fig. 5. Tables and graphical view screenshot.

Information: registered parameters in the “mediu\_pf.zgomot” table (Fig. 6)

Presentation mode: graps and tables

Navigation menu: sorted by p\_lucru from “mediu\_pf.zgomot” table

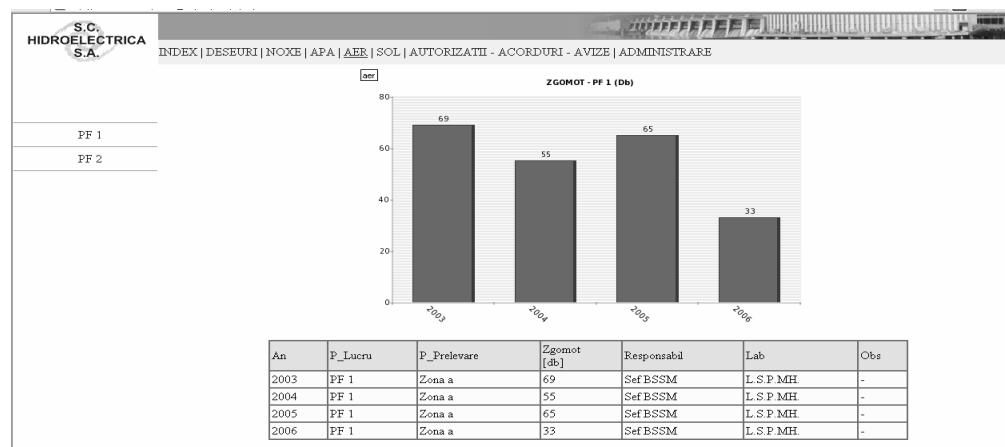


Fig. 6. Chart view screenshot.

## 5. Conclusions

The above database became in the last year a common tool for the environmental assessment of the IRON GATES power plants, generating a set of security actions. The web data access stimulated the public interest for limiting the dangerous operating regimes of the two hydropower plants.

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