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EFFICIENT MANAGEMENT OF THE DRINKING WATER DISTRIBUTION SYSTEM IN THE CITY OF IASI

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Abstract: *From the design stage, the lifetime distribution network must ensure an optimal balance between costs and revenues. In the context of the potential water sources have limited potential, their effective use is a major goal for which is important to allocate resources and set clear directions for action. Considering the current structure and distribution network based on information that we have, we have identified three major steps have to be taken:*
STEP 1: Creating database in GIS application framework, and highlighting the concept of effective management of drinking water distribution system in the city of Iasi.
STEP 2: Identifying opportunities and establishing DMA-s in the drinking water distribution network of Iasi municipality.
STEP 3: Interpreting data base and managing DMA-s.

Key words: *Water Distribution Network, Costs, Revenues, GIS application*

1. Introduction

The sound management of a drinking water distribution network is a complex and continuous process which must ensure an effective operational regime within the system, and involves an accurate structuring of information and the conversion of these data into reports on basis of which decisions can be made.

Starting with its design stage, and all along the lifetime of a distribution network, an optimal balance between costs and revenues must be provided. Considering that water sources are limited, an efficient use of these resources is a major goal. In order to reach this goal sufficient resources must be allotted and clear action directions must be defined.

Taking into account the current structure of the distribution network and based on data that we possess now, we have identified three major steps that have to be covered:

STEP 1: Creating a GIS database and highlighting the main elements that constitute the concept of effective management of the drinking water distribution system within city of Iasi.

STEP 2: Identifying opportunities and establishing microsectors within the drinking water distribution network.

STEP 3: Interpreting the main data and ensuring the microsectors' management.

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2. STEP 1 - Creating a GIS database and highlighting of the main elements that constitute the concept of effective

The Iasi City water distribution network includes all pipelines, fittings, measuring instruments and accessories that allow the conveying of water from storage tanks to the consumers' taps. The distribution network ensures the maximum hourly flow at the necessary service supply pressure and is ring-shaped (this bringing the advantage that water can reach any location from at least two directions).

The annular configuration of a water distribution network is optimal because it provides maximum operational safety (both at normal consumption flow and at firefighting special flows).

Moreover, in case of pipe failure on a network sector, only the consumers that are strictly connected to that sector shall suffer due to water cutoffs. Within a branched network, a failure on a pipe shall stop the water distribution towards the entire town sectors or industries that are located downstream of the failure point. Plus, a ring shaped network is significantly reducing the effects of water hammering.

As of 25.02.2011 the situation of the Iasi distribution network was the one shown below:

Features of the water distribution network in Iasi city

Table 1.

Material	Network type	Length [m]
Fd	---------------	14765
OL	---------------	40560
Fp	---------------	84384
Azb	---------------	18099
PVC	---------------	4104
PEHD	---------------	70555
Total length	**Secondary**	232467
Fd	---------------	3464
OL	---------------	82238
Fp	---------------	24269
Azb	---------------	1921
PVC	---------------	5640
PEHD	---------------	32050
OL/Zn	---------------	6557
Pb	---------------	330
Total length	**Supply**	156469
PEHD	---------------	1256
OL	---------------	18387
PREMO	---------------	35037
Fp	---------------	35219
Fd	---------------	3974
PAFSIN	---------------	7009
Azb	---------------	627
Total length	**Adduction**	101509
	Total	490445

It is crucial to define a set of standard maneuvers, enabling the company to precisely know which tank/pumping station is supplying the distribution network at one moment. Also, there is need to define the coverage areas of tanks/pumping stations:

- Storage tanks: Păcurari, Aurora, Mijlociu, Breazu, Şorogari, Ciric, CUG, Miroslava, Galata, Bucium IVV;
- Pumping stations: Păcurari, Aurora, Mijlociu, Bucium CUG, Chirita.

Each pipeline must have assigned a code corresponding to the tank/pumping station which supplies it with drinking water:

- adduction pipes;
- main pipes;
- service pipes;
- connections.

The geodesic level is defined in absolute coordinates hereinafter referred to as "C.T."

- storage tanks;
- pumping stations;
- adduction pipelines in knots;
- main pipelines in knots;
- service pipe towards connections.

In case we do not have information (GIS, topographic map, etc..) or if these do not meet the system's requirements, the land's level will be determined by direct measurement. The potential of each tank must be computed, that is the lower and upper limits between of which water can be used (in terms of geodesy). The consumed and stored energy will be used to cover pre-set areas. The minimum and maximum pressures that is to be provided in compliance to contract and to norms must be taken into account. Must be provided also the allotment for each pipeline of areas according to the buildings height regime, and depending on flow and pressure mentioned in the technical permit and, subsequently, the determining of pressure zones. These zones must be graphically delimited. Each pressure zone will have a color code allotted; hence, all the elements within that pressure zone (pipes, connections, taps, valves) shall bear the same color code.

 The superior zone: has a potential CT

(160 ÷ 120) m, delivers water to districts Copou, Agronomie, Crucea Rosie, Munteni and is supplied from Timisesti source via the Mijlociu pumping station and Breazu storage tank;

 The middle zone 1: has a potential CT

(120 ÷ 75) m and supplies water to districts Toma Cozma, Codrescu, Lascar Catargi, Universitate, Sararie, Ticau and is supplied from the 2x4.000 m³ tanks located in 6 Costachescu Street ;

 The middle zone 2: has a potential CT

(120 ÷ 75) m and supplies water to districts Toma Cozma, Codrescu, Lascar Catargi, Universitate, Sararie, Ticau and is supplied from the Aurora 2x4.000 m³ tanks;

 The inferior zone: has a potential CT (80

÷ 35) m and supplies water to districts Pacurari, Canta, Dacia, Alexandru cel Bun, Mircea cel Baran, Cantemir, Nicolina, CUG, Podu Rosu, Bularga, Tudor Vladimirescu, Centru and is supplied with water from:
- Prut river / lake Chirita via the 4x5.000 m³ tanks from Sorogari Plant;
- Prut river / lake Chirita Chirita through the Chirita pumping station;
- Timisesti source via the Aurora 2x10.000 m³ tanks. This area includes both enterprises from the former industrial zone and also some residential neighborhoods located on the lowest plateau of Iasi City;

In this zone, considering the terrain features, the next subzones are identified:

 The Galata-Miroslava high subzone –

supplied via the Galata pumping station, Galata booster pump and Galata tank;

 The Bucium high subzone - supplied by

Bucium pumping station, boosting pump located at Bucium IVV tank and the Bucium IVV tank;

 The Moara de Vant high subzone, the

Ciric recreational area, supplied by the Sorogari and the Ciric tanks/Sorogari water tower;

 A subzone with P+8/P+10 appartment

blocks within Dacia and Pacurari districts, supplied by the “Octav Bancila” high-pressure pumping station (Q = 285 l / s, H = 55 mwc);

 A subzone with P+8/P+10 appartment

blocks within Alexandru cel Bun and Mircea cel Batran districts, supplied by the Cerna high-pressure pumping station (Q = 263 l / s, H = 55 mwc);

Piezometric lines are to be drawn, by starting from storage tanks, for all adduction and main pipelines. In each node available pressures and characteristic sections are to be established.

 pressure and flow measurements must be carried in all relevant nodes and points;

 for each pressure zone the most unfavorable points shall be identified (that is those with the minimum pressure that can be provided);

 data supplied by operational monitoring systems are to be used;

3. STEP 2 - Identifying opportunities and establishing microsectors within the drinking water distribution network

There is need to reconfigure the architecture of the drinking water distribution system according to the principle of an unique supply, hereinafter named “the main supply”, for a standard operation that offers also the possibility of to start-up a second supply in case of emergency.

On the second supply, hereinafter named "the secondary supply" the valve must be left in “normally closed” position.

The dual supply and the possibility to feed the microsector from two main networks ensures the microsystem’s independence and, hence, the water cutoffs durations will decrease (in case of failure interventions or planned works on network).

The measuring device (water meter or flowmeter) will be installed on the main supply and the following types are identified:

- permanent measuring on all pipe diameters, with electromagnetic flowmeter equipped with totalizer and local reading, or with remote transmission;

- permanent measuring on pipes having diameters of (50 ÷ 200) mm (Syble system water meter);

- measurings at preset time (temporary installation) for all pipe diameters, with an UDM 100/UDM 200 portable flowmeter;

In order to create a microsector the distribution network’s technical characteristics must be assessed and known and the next goals must be achieved:

- the existence of only one main pipeline (as much as possible to avoid the duplication of networks having the same pressure regime);

- all service pipelines must be connected to the main pipe;

- Connection identification (maneuvers, tracking with route locator, etc.)

- Entering the information in the graphic database

- all valves to be checked in order to ensure their correct operation in positions full closed/full open;

- will be taken into account the completion of new links, installation of valves, suppression of some connections;

- on network, ports will be created for mounting the noise listening and measuring devices (correlators), used to detect failures and leaks.

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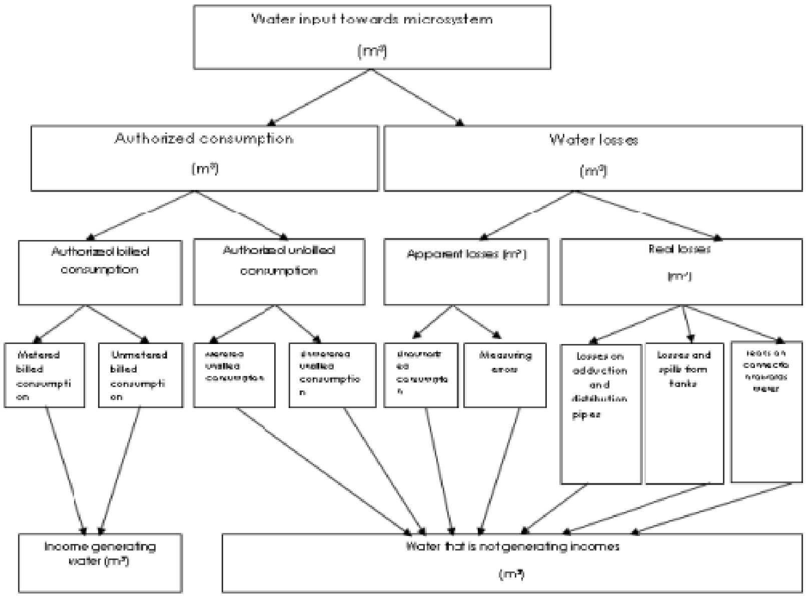

Fig. 1

Consumers must be identified on each microsector. Consumption shall be allotted to them, on basis of water meter indexes (the basis of water billing). Consumers may be:

- Domestic customers;
- Housing associations;
- Businesses.

A software will be developed, that is a software which automatically shall collect data on clients' water consumption and transcribe them in Excel format in order to allow a comparative analysis

4. STEP 3 -Interpretation of main data and the management of microsectors

Taking into account the technical possibilities of the company two ways of data recording and interpretation are identified:

- Readings carried at night, when, theoretically, the water consumption is minimal; the meter readings at different moments will lead to the figure for the leakages on this section and the volume of lost water.
- The water balance method in accordance with IWA (figure 1).

5. The authorized consumption

Billed authorized consumption:

- The measured billed consumption:
   water billed on basis of water meter readings (devices installed on customers' connections)
   water billed and conveyed by tanker on customer request
- Unmeasured billed consumption:
   water billed in Pauschal system (lump sum billing);
   water supplied during summertime to unmetered public fountains;
   water used for firefighting (only Emergency personnel only), water drawn from street hydrants;
   activation for short periods (firefighting, etc.) of connections that bypass the water meter (at enterprises/businesses);
   washings of septic pits (commercial);
   capital works completed on own site.

Un-billed authorized consumption:
- Measured unbilled consumption
 water consumption of own facilities (in-doors consumption)
- Unmeasured unbilled consumption:
a. Works performed by the Distribution Department:
 water within the isolated pipe section of pipe by closing of line valves and drained to sewers, in accordance with the standard method statement for failure repairs;
 water used for washings of isolated pipe section, after completion of works, in accordance with the standard method statement for failure repairs;
 water used for the washing of the tanks managed by the Distribution Department (cleaning up of residues and contaminants, in compliance to the "tanks washings" planning);
 authorized pipe washing works (authorized by "pipe washing" planning);
 pipe washing works carried ahead of schedule, and instructed on basis of quality tests conducted by the Quality-Environment-Laboratories Dept.
b. Works performed by the Sewers Department:
 water used for current maintenance/intervention works performed with the sewage trucks (water from distribution system, drawn from fire hydrants, via mobile systems with the aim to flush / declogg /clean-up the sewers);

6. The water losses

Apparent losses
- water theft: illegal connections, meter bypassing pipes, illegal use of fire hydrants, illegal use of ventilation ports, various discharges;
- commercial losses due to different readings on customers' water meters
- reading / billing errors.

Real Losses
- losses in distribution pipelines;
- accidental losses and spills from tanks;
- losses (leakages) on connections up to the water meter point.

Developing a "micro-sector data sheet" model which shall contain essential information, structured by category, as it follows:
- pipe material, lengths, diameters
- pipeline commissioning year
- number of customers / connections, by categories
- method of flow computing
- interventions performed: failure repairs, pipe washings, connection of new customers, suppressions of existing connections, replacement of connections / networks, etc.
- amount of unbilled metered water
- objectives/activities of the companies that use a drinking water connection.

7. Conclusions

The decreasing of amounts of water lost through seepage from distribution pipes is a major goal for the safe operation of water distribution system. In this regard, a priority is to identify the areas where water losses of water are detected.

In distribution systems having high network lengths (over 400 km), different pipe materials and ages of more than 40 years, the micro-sectorization is the main tool by which a company may intervene in order to provide an efficient management and control of resources and water losses.