NRW data capturing and management
SISCOPE – Water Loss Management System

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INTRODUCTION

The scarcity of water resources is a concern that currently rages across the globe, including countries that have historically abundant water sources, such as Brazil. The International Water Association (IWA) announces long the water balance (BH) as one of the main tools to control and reduce losses of water distribution systems.

In search of efficiency of water use, the sanitation sector can contribute to the awareness and consumption of control acting on the real and apparent losses in order to act on the demand and do not need to increase investment, increasing in the pursuit of expansion of supply.The CAGECE, Water and Sewage Company of Ceará, has been undergoing upgrades and innovations to continue to maintain a competitive and updated company, aiming at the continuous search for the execution of their mission. It has in its policy commitment to the public water supply the best possible way, from the continual refinement of techniques and methods used.

Although the final master plan for the metropolitan region of Fortaleza has recently been completed, the suggested actions in relation to the same loss control are in the design phase. The main action will be the division of the integrated system of 121 districts in the metropolitan area monitoring and control (DMCs), which undoubtedly will facilitate the operational management and will bring a significant reduction of losses. It will be easier to identify the root causes, in addition to support the management of pressures for each system independently. For managing loss from this kind of actions, Cagece has developed its own software, called Siscope. The Siscope aimed the improving of the operational management and consequent reduction of energy consumption and water losses. Monitoring through the water balance with a high level of detail allowed the operational optimization in relation to supply, as well as subsidizing actions to mitigate losses in supply systems.

Information was provided transparently to the users in a database, facilitating and enabling the use of updated information at any time, via the intranet. It presented a technical description of a system that allows the use of operational management information in an integrated and focused on a broad, strategic analysis of key indicators related to loss control.

OBJECTIVE

The customized water balance, main tool of Siscope, aimed at improving the operational management and a consequent reduction in energy consumption and water losses. Monitoring through the water balance enables operational optimization in relation to supply, as well as subsidizing mitigation of losses in supply systems. Information was provided in a transparent manner to the user in a database, facilitating and enabling the use of updated information at any time. Through this work, presented a technical description of a system that allows the use of operational information management in an integrated and focused on a broad, strategic analysis of key indicators related to loss control. The customized and automatized real time water balance also aimed to provide easy maintenance and low cost, short implementation time, possibility of expansion of system functions for other needs, standardization, and ease of use, with friendly interface and wide dissemination through the web platform and access via intranet.

METHODOLOGY USED

It is important to characterize the concept of loss of water which, broadly speaking, correspond to all unauthorized consumption, which determine the increased cost of operation or prevent the full realization of operating income and these include:

Real Losses (Physical) arise from leaks in the system, networks, stations and accessories as well as extravasation in reservoirs.
Apparent Losses (not physically) come from unauthorized consumption, problems with the registration and billing, as well as the vagueness of metering equipment.
From the point of view of results:

- The reduction of apparent losses can increase revenue, improve efficiency of services and financial performance. Indirectly contributes to increasing the effective supply since it leads to waste reduction.
- The reduction of real losses reduced costs of water production - by reducing consumption of energy, chemicals, outside services and other supplies - and use existing facilities to increase supply without expanding the supply system.

The Siscope has been developed that integrates the various systems and databases from a sanitation company in a single system and database itself, also causing a backup of the original data. The system aimed to the input of management tools to analyze, record and monitor the results of actions, enabling their technicians to identify solutions to manage the losses, which increased the efficiency and effectiveness of actions. The Siscope was prepared with the following modules:

Water Balance and Losses Indicators
The Siscope calculates and allows, from an evolution of the basic structure defined by IWA - International Water Association, monitoring, according to the supply system, the reference month and in great detail the various components of the Water Balance. The Siscope calculates and allows monitoring the evolution of the five main indices and indicators of losses, and other physical and commercial through charts and graphs.

Macrometering
The Siscope enables the release of volumes distributed by Macro meters, segmented by sector supply for periods of measurement, providing the Volume spread the month closed or within a defined period, taking into account the errors of measurement of each meter pre-registered.

Micrometering
It has specific tools for both the small consumers, as for large ones. The criteria for extraction and analysis of reports are based on specific criteria to define the demands of work in meters, with regard to:
Corrective maintenance: identifying the meters currently stopped, unable to reading achievement and others.
Preventive Maintenance: allowing direct actions with respect to the development of a preventive maintenance plan.
Downsizing: evaluation of the meters that can be resized.
The Siscope provides a tool that incorporates the concept of best gauge for a particular customer's point of view on economic and financial. That is, from the technical characteristics of the meter in question (capacity, class metrology and the error curve) and the consumption profile, it is possible to compare patterns of all the meters registered in its database with that existing, as well as best value cost / benefit based on increased Net Present Value-NPV and payback period on investment.

Management of micrometering
The micrometering is one of the most important and comprehensive topics, in part because it represent, in general, the most significant portion of the apparent losses, excluding fraud.

Several studies in the laboratory of Cagece with various brands of water meters indicated that it is economically viable to maintain the park with an average age of about 3 years (actually 3.2 years). With the extrapolation of data from these studies, it was possible to develop an abacus which depicts the situation of Cagece's park of meters (Figure 01).

Time (years)	Loss (m3)	Loss (%)	Time (years)	Loss (m3)	Loss (%)	Time (years)	Loss (m3)	Loss (%)
0		0,00	4	0,80	6,43	8	2,06	16,48
0,1	0,03	0,21	4,1	0,82	6,53	8,1	2,11	16,85
0,2	0,05	0,42	4,2	0,83	6,64	8,2	2,15	17,21
0,3	0,08	0,64	4,3	0,84	6,75	8,3	2,20	17,58
0,4	0,11	0,85	4,4	0,86	6,85	8,4	2,24	17,95
0,5	0,13	1,06	4,5	0,87	6,96	8,5	2,29	18,32
0,6	0,16	1,27	4,6	0,88	7,07	8,6	2,34	18,69
0,7	0,19	1,48	4,7	0,90	7,17	8,7	2,38	19,05
0,8	0,21	1,70	4,8	0,91	7,28	8,8	2,43	19,42
0,9	0,24	1,91	4,9	0,92	7,39	8,9	2,47	19,79
1	0,27	2,12	5	0,93	7,44	9	2,52	20,16
1,1	0,29	2,33	5,1	0,97	7,74	9,1	2,57	20,53
1,2	0,32	2,54	5,2	1,01	8,04	9,2	2,61	20,89
1,3	0,34	2,76	5,3	1,04	8,34	9,3	2,66	21,26
1,4	0,37	2,97	5,4	1,08	8,64	9,4	2,70	21,63
1,5	0,40	3,18	5,5	1,12	8,95	9,5	2,75	22,00
1,6	0,42	3,39	5,6	1,16	9,25	9,6	2,80	22,37
1,7	0,45	3,60	5,7	1,19	9,55	9,7	2,84	22,73
1,8	0,48	3,82	5,8	1,23	9,85	9,8	2,89	23,10
1,9	0,50	4,03	5,9	1,27	10,15	9,9	2,93	23,47
2	0,53	4,24	6	1,31	10,45	10	2,98	23,84
2,1	0,54	4,35	6,1	1,34	10,75	10,1	3,03	24,21
2,2	0,56	4,45	6,2	1,38	11,06	10,2	3,07	24,57
2,3	0,57	4,56	6,3	1,42	11,36	10,3	3,12	24,94
2,4	0,58	4,67	6,4	1,46	11,66	10,4	3,16	25,31
2,5	0,60	4,77	6,5	1,50	11,96	10,5	3,21	25,68
2,6	0,61	4,88	6,6	1,53	12,26	10,6	3,26	26,05
2,7	0,62	4,99	6,7	1,57	12,56	10,7	3,30	26,41
2,8	0,64	5,09	6,8	1,61	12,86	10,8	3,35	26,78
2,9	0,65	5,20	6,9	1,65	13,16	10,9	3,39	27,15
3	0,66	5,31	7	1,68	13,47	-11	3,44	27,52
3,1	0,68	5,41	7,1	1,72	13,77	11,1	3,49	27,89
3,2	0,69	5,52	7,2	1,76	14,07	11,2	3,53	28,25
3,3	0,70	5,63	7,3	1,80	14,37	11,3	3,58	28,62
3,4	0,72	5,73	7,4	1,83	14,67	11,4	3,62	28,99
3,5	0,73	5,84	7,5	1,87	14,97	11,5	3,67	29,36
3,6	0,74	5,95	7,6	1,91	15,27	11,6	3,72	29,73
3,7	0,76	6,05	7,7	1,95	15,57	11,7	3,76	30,09
3,8	0,77	6,16	7,8	1,98	15,88	11,8	3,81	30,46
3,9	0,78	6,27	7,9	2,02	16,18	11,9	3,85	30,83

Figure 01 - Accuracy of Cagece's park of meters

Audit and Fraud Regularization and Anomalies in Field

This module was designed tools to help manage the occurrences of fraud and other irregularities committed by consumers. The module manages the research of fraud and irregularities, and is responsible for issuing police reports and work orders.

Research and Leak Repair in non-visible field

This module seeks to assist in managing the systematic research of non-visible leaks and their repair. The module includes tools for managing the research of non-visible leaks from the registration of stretches surveyed, the issue of research bulletins, work orders and repair their bulletins.

IWA Water Balance

The basic structure defined by the IWA - International Water Association is represented in Figure 02.

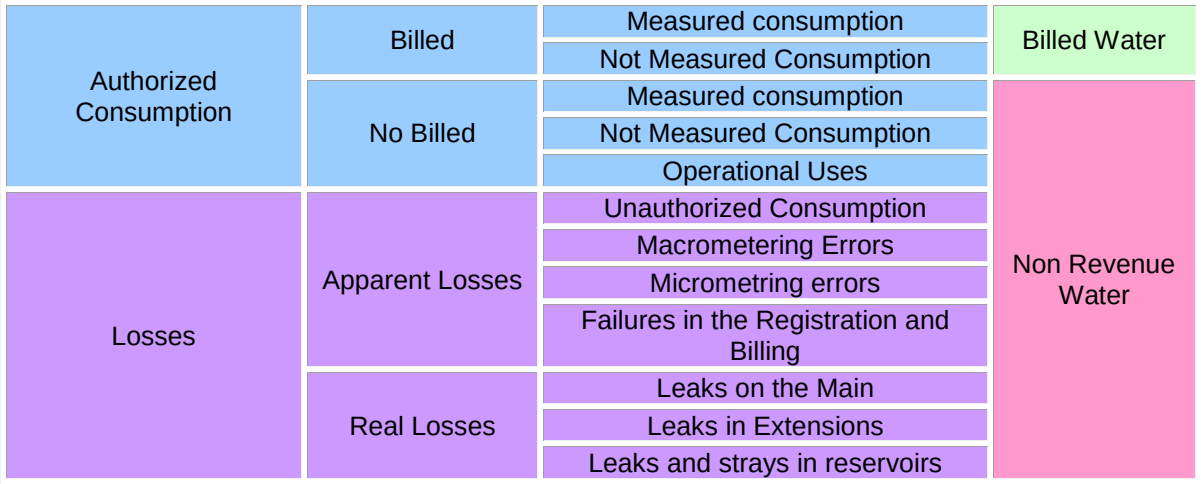

Figure 02 - IWA Water Balance

The water balance in its basic form allows a first approach to identifying the main causes of losses, but to prioritize actions to combat loss more effectively, it is necessary to detail the fields of the original balance.

Indicators

In parallel, it is recommended to follow up the evolution of the main indicators of loss, calculating and presenting at least the following indexes:

Losses in Distribution Index - *IPD (%)*

$$IPD = \frac{(\text{Volume Produced} - \text{Volume Consumed})}{\text{Volume Produced}} \times 100$$

Income index (performance of Billing System) = IF (%)

$$IF = \frac{\text{Volume Consumed} \times 100}{\text{Volume Produced}}$$

Linear Index of Gross Losses (m^3/day.Km) = ILP or LLI (Linear Loss Index)

$$ILP = \frac{(\text{Produced Volume} - \text{Volume Consumed})}{\text{Network Extension}}$$

Index of Gross Losses per Connection (liters / day.connection) = IPL

$$IPL = \frac{(\text{Volume Generated - Consumed Volume})}{\text{Amount of Active Connections}}$$

Non Revenue Water = IANF = NRW

RESULTS OBTAINED

Ability to manage losses fighting the root causes, enabling rapid and efficient return of actions taken. After selecting the period of the universe and data range (scope) to be searched, the Siscope does all the calculations, searching the data-base systems in real time and provides an assessment with a high degree of detail, as figures 03 and 04 .

All components of the water balance were reviewed and properly customized.

The customized water balance also showed highly consistent, with several detailed management information to support decision making. With the generation of the detailed water balance, all managers of water supply systems have gained a powerful tool for decision making, because it allows to manage losses fighting the root causes, enabling rapid and efficient return of the actions taken. The system met the objectives pursued, becoming a practical tool and user-friendly interface.

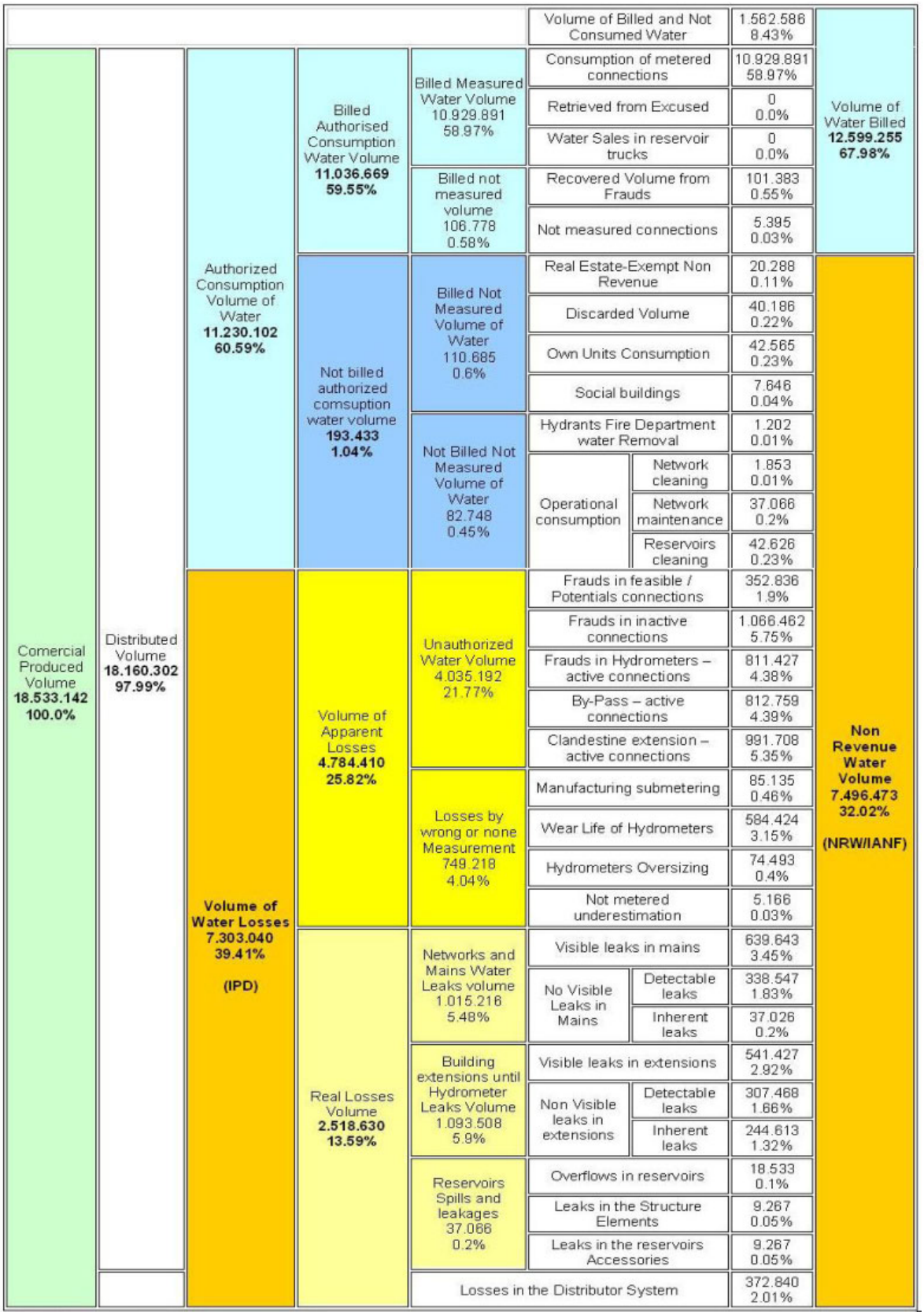

Figure 03 - Analysis of data from Fortaleza's water balance

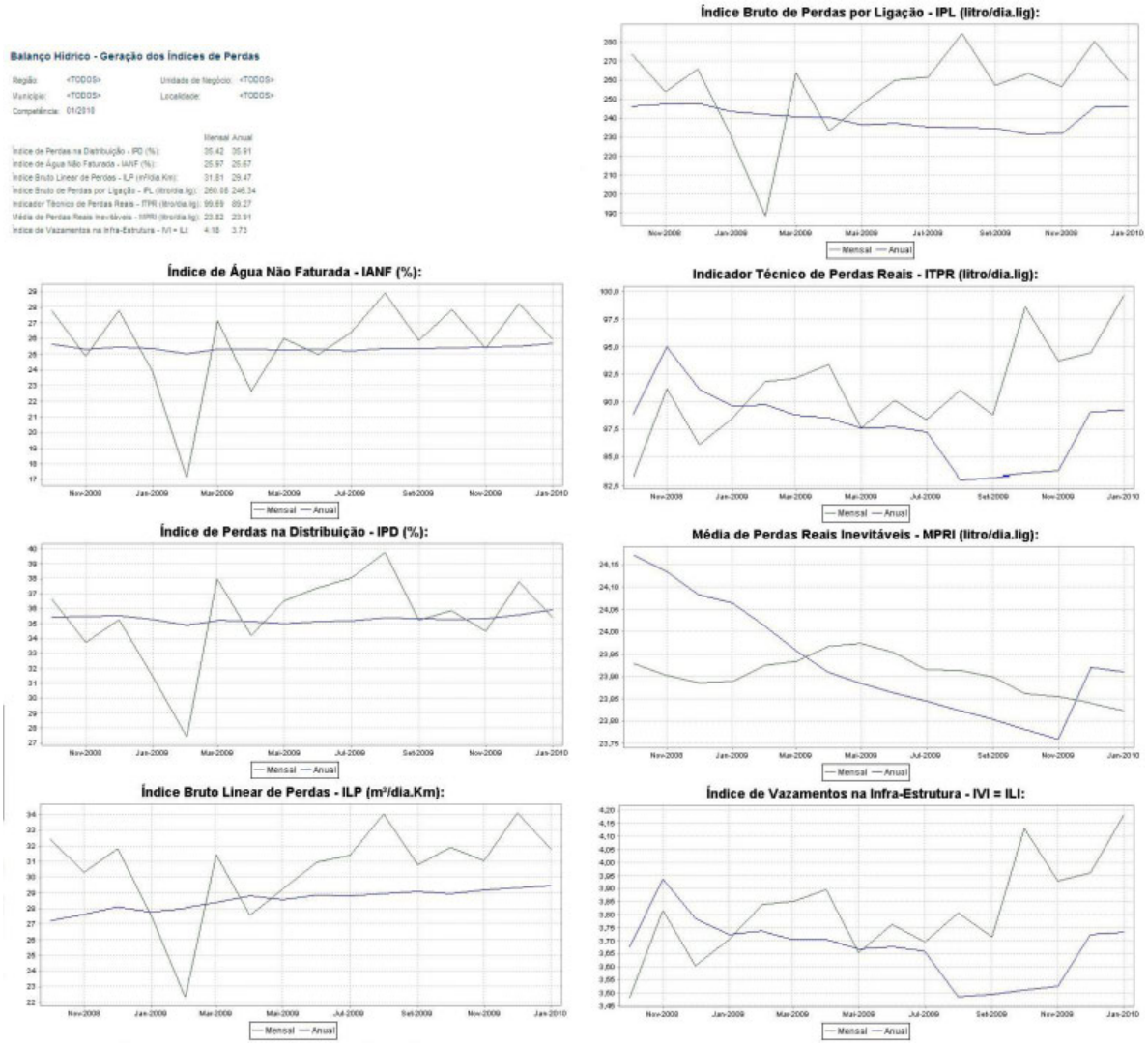

Figure 04 - Generating management graphics indicators

CONCLUSIONS

With the implementation of Siscope, all water supply systems in the state of Ceará had substantial gain in operating procedures, so that distribution losses tend to fall as they perform actions focused on the main causes of losses, such as avoiding unnecessary high pressures that cause leaks throughout the network met. The volume lost before it becomes a greater water reserve of water sources, ensuring a strategic reserve for the supply, and preserve water resources of the environment.
The development of customized and automated BH also allowed:

- A very quick return on investment, thus proving its efficiency in actions to combat water loss;
- Reduce the amount lost in leaks, saving water resources and associated costs;
- Provide a service with greater safeguards for consumers, reducing the occurrence of shortages;
- Optimize system operation, in order to support maneuvers in order to avoid water shortages at critical points;
- Subsidizing the design of sub-sectors hydraulically confined;
- Subsidizing programs for leakage control, micro and macrometering.

The customized water balance also gave support to the Company's strategic management and support, helping to achieve significant results in reducing losses, as is shown in figure 05. Users of the Business Units has also initiated the development of corrective and preventive loss control based on the use of customized water balance.

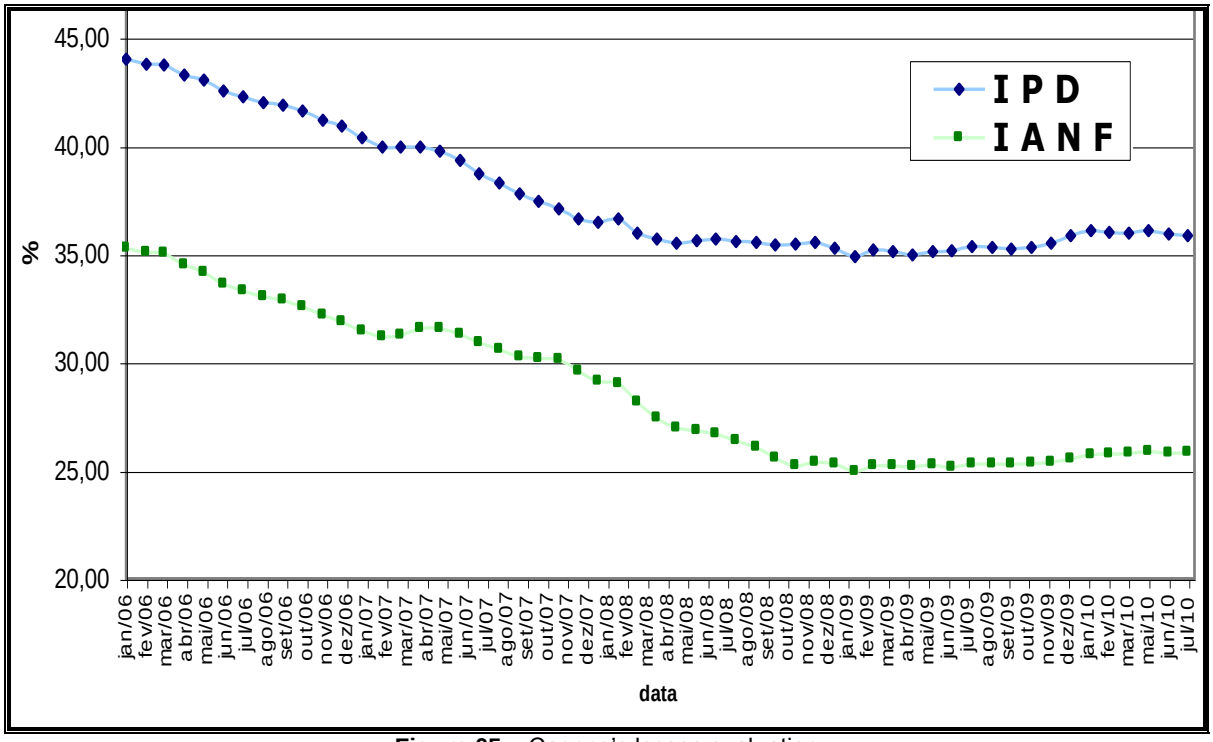

Figure 05 – Cagece's losses evaluation

RECOMMENDATIONS

It is recommended the constant review and maintenance of the system, where it will should fit completely on the system architecture in the enterprise and its integration with other in development or already deployed, such as the Commercial System.

Review and Maintenance
Should be provided for the deployment members activities and validation tools of the Siscope. In parallel, should be offered the necessary training to all users.
The following steps are recommended:

- Plan implementation;
- Survey and review of existing systems (databases);
- Customization;
- Final tests;
- Plan user training;
- Implementation of user training;
- Evaluation of user performance;

- Monitoring reports within 30 days of deployment, with all instances, performance measurement and adjustments, and deadlines;
- Implementation of system analysis, programming and parameterization of the system, with monthly meetings of control;
- Analysis of adherence to the system macroprocess.

With regard to maintenance, should be made periodic monitoring of the system, aiming to solve problems and doubts related to the sporadic use. Are recommended daily backups and security procedures in the database.

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