



# SGP - HYDRO ALUNORTE

## Loss Management System

### Motivation, conception and recent results

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# Agenda

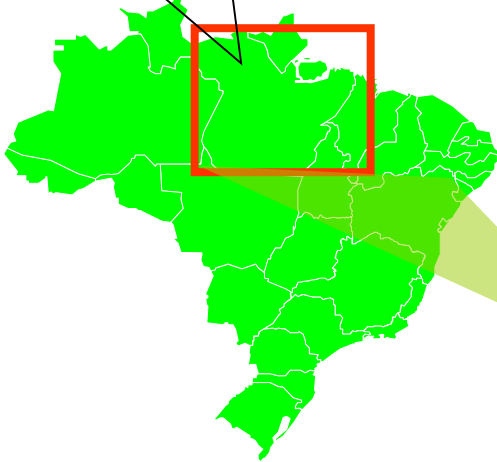
- About Hydro and PI System
- Project Motivation
- Used Architecture and Technologies
- Generation and Characterization of Loss Events
- Reports Searching Results
- Conclusion and Future Vision



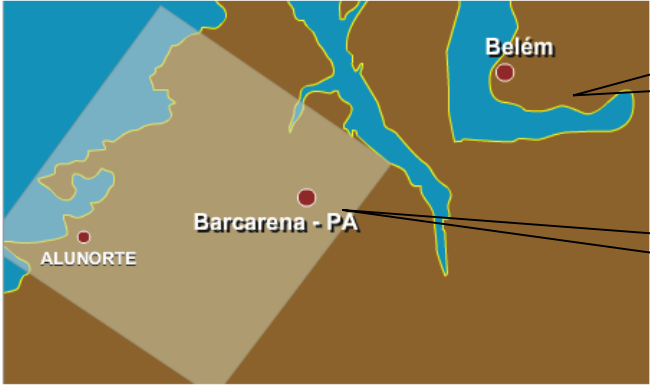
# About HYDRO and PI System

# About HYDRO - Alunorte

Pará  
Total area: 1.247.689,515 km<sup>2</sup>  
Population: 7.431.020



Belém  
Total area: 1.819 Km<sup>2</sup>  
Population: 2.105.621  
(Metropolitan Area)



Barcarena  
Total area: 1.310 Km<sup>2</sup>  
Population: 92.567

# About HYDRO - Alunorte

- Start up in 1995, with the design capacity of 1.1Mtpy of alumina.
- Nowadays, Hydro Alunorte exports its products to 10 countries, from the Middle East, North America and Europe.
- Around 4.400 total employees, direct and temporary contractors.

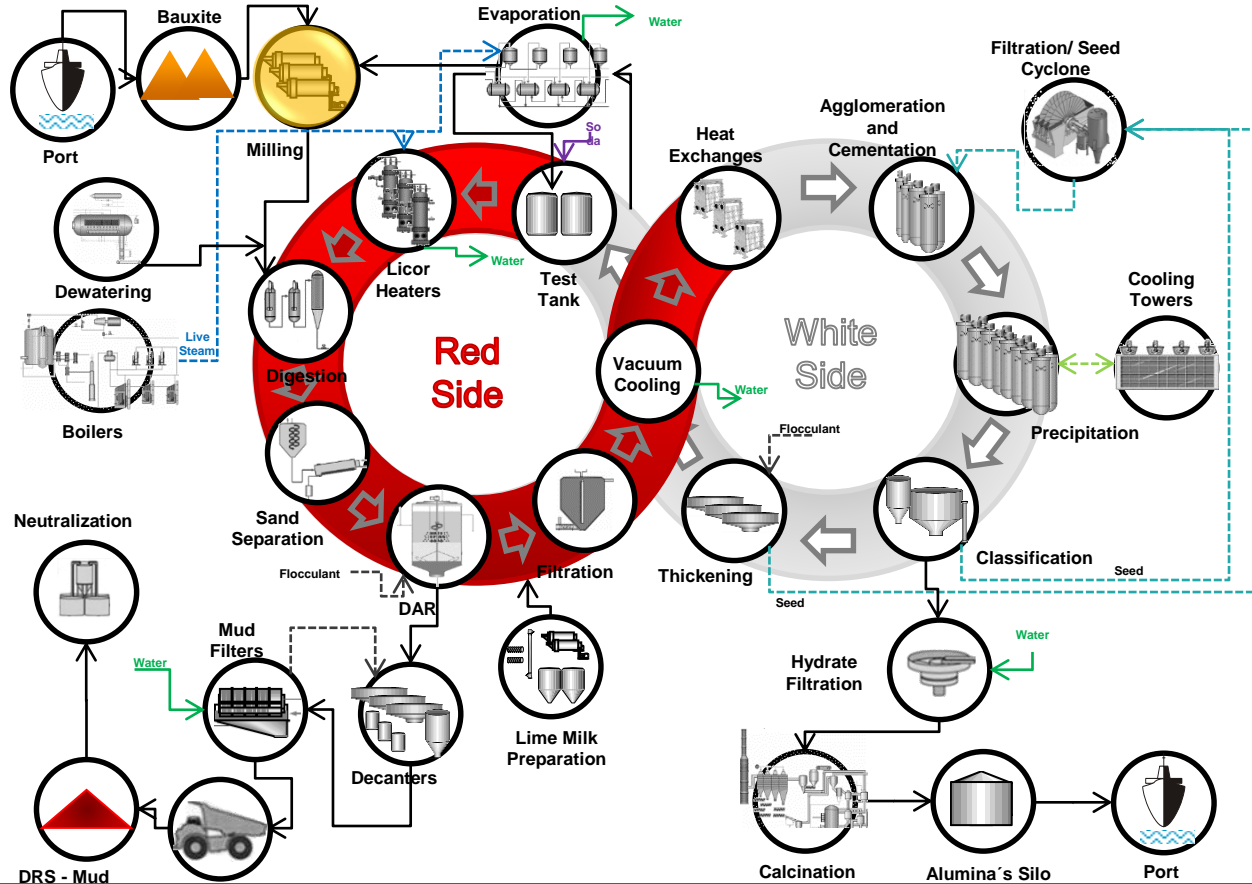


# About HYDRO - Alunorte

The current capacity is 6.30Mtpy, after the expansion 3 completion.  
In 2016 we have achieved 6.34Mtpy of alumina.



# About HYDRO - Alunorte



# PI System HYDRO - Alunorte

**PI System** has been installed in HYDRO - Alunorte since 2000, totaling 17 years of historical data and several applications based on its data. Currently HYDRO is licensed and uses all the available tools on the PI Server.

PI Server 2015

28.465 points

Asset Framework 2016

More than 40.000 elements





# Project Motivation

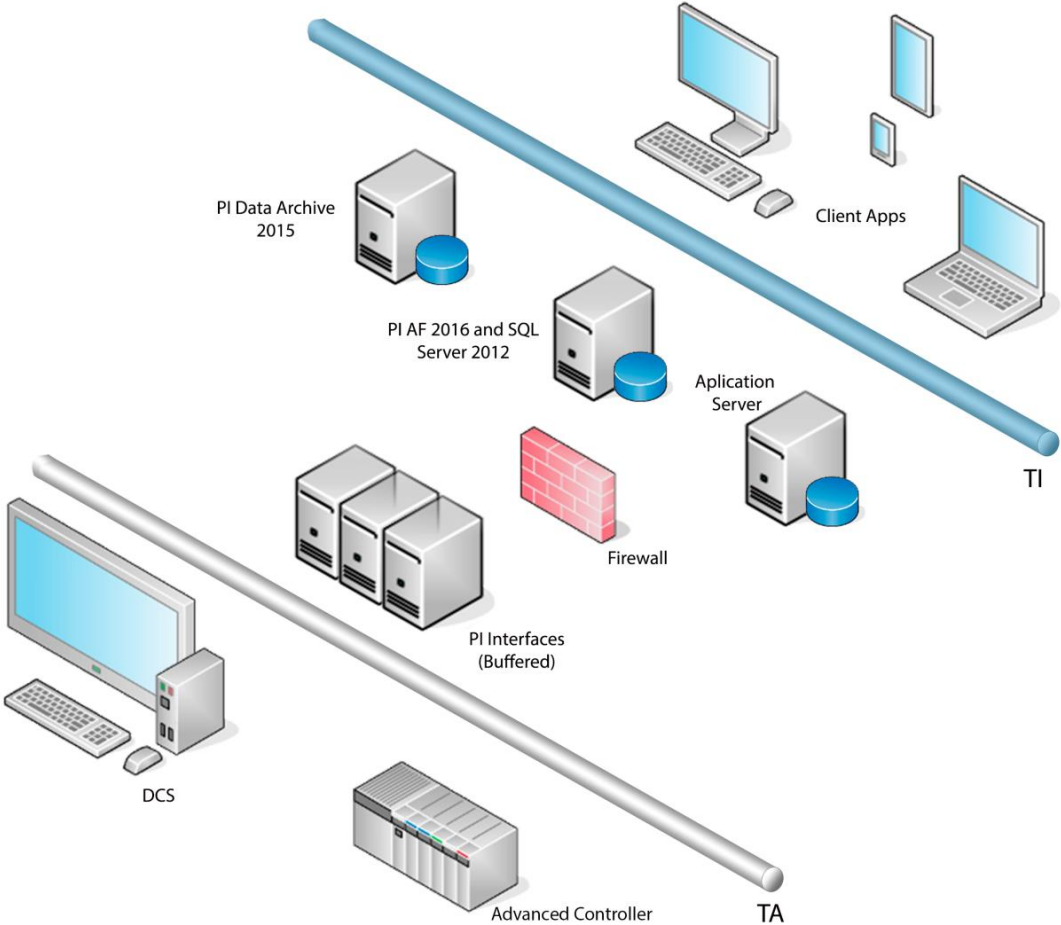
# Project Motivation

- The control of loss of production in HYDRO Alunorte has been controlled for a long time. However, until this project, it was done manually and spending many engineering hours in the consolidation of information.
- Although using the [PI Server](#) flow tags, the loss times were manually recorded, the calculations were performed in MS Excel and the reports were mounted one by one based on the information collected.
- With the emergence of [AF SDK](#), doors were opened, so new applications automating the entire process were created, and so the idea and need for the Loss Management System (GSP) was born.



# Used Architecture and Technologies

# Architecture



# Used Technologies

HYDRO - Alunorte was concerned with using the latest technologies with the latest available versions of each platform at the time the system was designed.

It is a concern of the company to keep abreast of all tools that directly and indirectly affect the performance of the [PI System](#).

# Used Technologies

For the design of this system, the following technologies were used:

- The web system was developed using C #, Javascript and HTML5;
- The relational database used to store all system information is SQL Server 2012;
- The tags that monitor the flow of each production line, responsible for generating loss events, are registered in the [PI Server 2015](#);
- The generation of loss events is done through a webservice that is triggered by [Notifications](#);
- The entire hierarchical structure of lines, areas, subareas and equipment of the system is registered in AF 2016, totaling more than 40 thousand elements that are requested by the system through [AF SDK](#).

# Used Technologies

The screenshot displays the PI System Explorer interface, showing a tree view of elements and a configuration window for a notification.

**Tree View (Left Panel):**

- HYDRO - Alunorte
  - GENER
  - GEPOR
  - GETAE
  - GEVAP
  - Linha 1
  - Linha 2
  - Linha 3
  - Linha 4
  - Linha 5
  - Linha 6
  - Linha 7

**Notification Configuration (Right Panel):**

Target: \\ALNPIAF1201\Monitoramento de Ativos\LFC Controle de Perdas(Linha 1)

Conditions:

Rule	Configuration	Time True	Result ...	Priority
PerformanceE...	'Vazão da linha' > 'Meta'	30	Outsid...	Normal

Options:

- Notify only on change in status
- Resend Interval: 0 Seconds
- Non Repetition Interval: 0 Seconds

# Used Technologies

The screenshot displays the PI System Explorer interface. On the left, a tree view shows the hierarchy of elements under 'HYDRO - Alunorte', including 'Linha 1', 'Linha 2', and 'Linha 3'. The main window shows the 'Attributes' tab for 'Linha 3'. A table lists the following attributes:

Name	Value
Código	0
Margem	50
Meta	1100
Vazão	1132.162841796875

On the right, a properties panel shows fields for Name, Description, Properties, Categories (set to 'Sistema de Gerenciamento de Perdas'), Default UOM, Value Type (<Anything>), Value, and Data Reference. A 'Settings...' button is also visible.



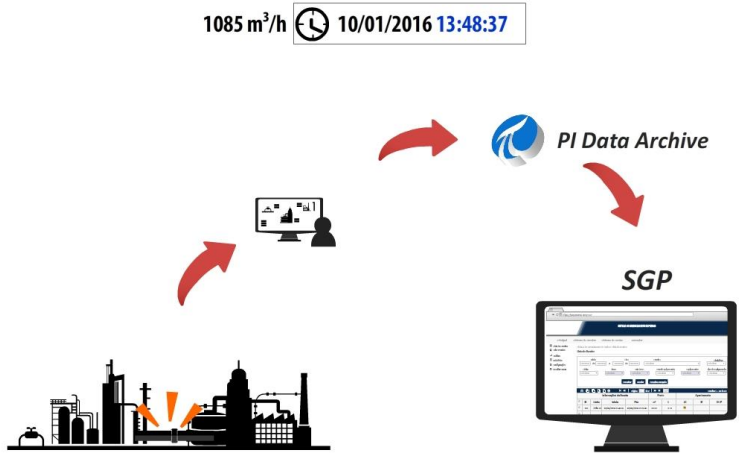
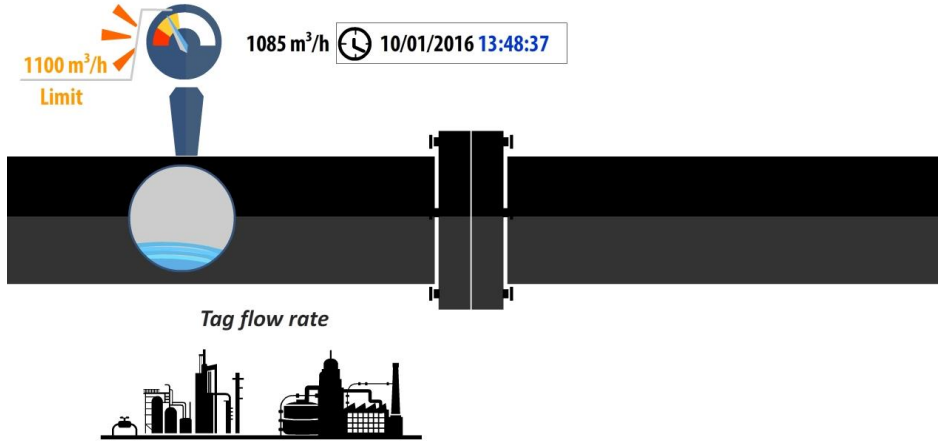


# Generation and Characterization of Loss Events

# Generation of Loss Events

- **Notifications** monitors the flow tags of each HYDRO - Alunorte line. Each line has a production target given in  $\text{m}^3 / \text{h}$ , recorded in **AF**.
- Whenever the flow of this tag falls below the target for the time set in the Notification True Time, **Notifications** triggers a webservice that starts the loss calculation of event.

# Flowchart of generation of loss events




# Calculation of Loss by Event

- The webservice, after receiving the flow rate tag, start time and end time of the **Notifications** event, calculates the loss using **AF SDK** methods and then sends them to the web system.
- AF Time Weighted Loss Totalizer SDK:

```
AFValue totalPerdaList = piPoint.Summary(timeRange, AFSummaryTypes.Total, AFCalculationBasis.TimeWeighted, AFTimestampCalculation.Auto)[AFSummaryTypes.Total];
```

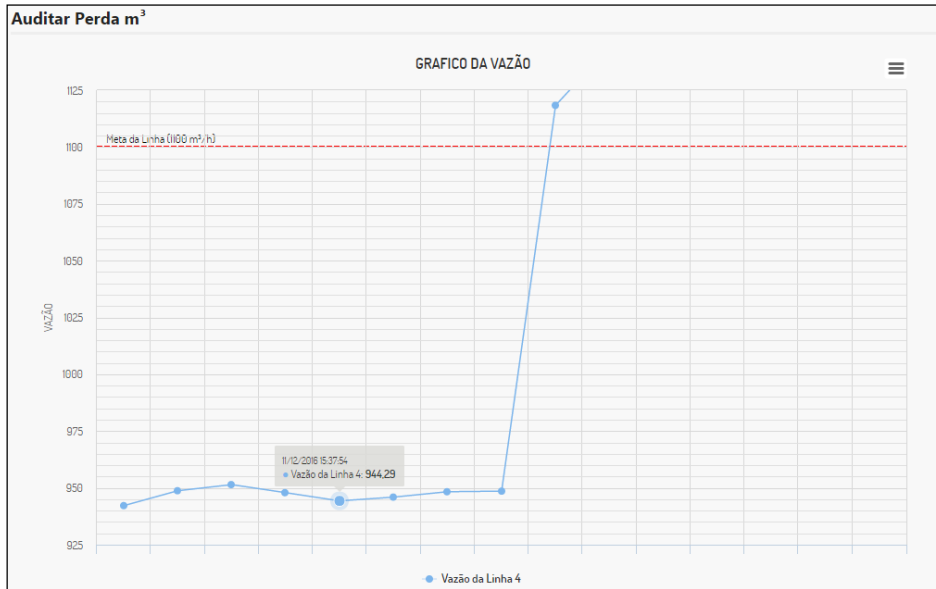
# Generation of Loss Events

- After the loss event is detected through the rules set in **Notifications** it is opened in the SGP for handling, with the loss in m<sup>3</sup>:

<input type="checkbox"/>	2277	Linha 5	08/12/2016 09:00:02	08/12/2016 09:40:04	23,79	2,32			
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# Generation of Loss Events

If the user, have any doubt about any event data generated by the system, he can use the loss audit to check the **PI Server** data used to generate and calculate the loss.



Período	
Início	Fim
11/12/2016	11/12/2016
15:37:30	15:38:46

Perda m<sup>3</sup> = (Meta da linha \* Duração do evento em horas) - (Vazão do período totalizada \* Fator de conversão)

$$1,37 \text{ m}^3 = (1100 * 0,02) - (0,91 * 24)$$

Parâmetros	Valores
Meta da Linha	1100 m <sup>3</sup> /h
Duração do evento (horas)	0,02 h
Vazão do período totalizada	0,91 m <sup>3</sup>
Fator de conversão	24 horas

Resultados	Valores
Meta do Período	23,22 m <sup>3</sup>
Vazão Total do Período	21,84 m <sup>3</sup>
<b>Total de Perda</b>	<b>1,37 m<sup>3</sup></b>

# Characterization and Detailing of Loss Events

The detailing and characterization of the event are done through the web system using the information of the **AF** as a basis.

The screenshot shows the 'PORTAL AUTOMAÇÃO' web interface. The top navigation bar includes the HYDRO logo, the title 'PORTAL AUTOMAÇÃO', and the TSA and LYNX PROCESS logos. Below the navigation bar, there are tabs for 'Principal', 'Sistemas', and 'Gerenciar', along with a user profile 'admingeral'. The main content area is titled 'Sistema de Gerenciamento de Perdas > Apontar Evento'. On the left, a sidebar menu contains options like 'Lista de Eventos', 'Meus Filtros', 'Criar Evento', 'Gráficos', 'Relatórios', 'Configurações', and 'Recolher Menu'. The central form, titled 'Apontamento de evento', includes fields for 'Linha' (set to 'Linha 4'), 'Apontamento do Evento:' (with a dropdown), 'Evento\*:' (with a dropdown), 'Relacionado à Equipamento\*:' (with a dropdown), 'Área\*:' (with a dropdown), 'Sub-área\*:' (with a dropdown), 'Disciplina\*:' (with a dropdown), and 'Observação:'. A 'Resumo dos eventos' box on the right displays event details: ID: 2286, Início: 11/12/2016 às 15:37:30, Fim: 11/12/2016 às 15:38:46, Perda: 1.37 m<sup>3</sup> and 0.13 t, and an 'Auditar Perda m<sup>3</sup>' button.

# Characterization and Detailing of Loss Events

The events receive an initial detail, and then go to characterization of the specialized team, maintenance or process.

**Detalhamento do Evento - Manutenção (Equipamento - T-02C-05A Tanque de armazenagem de polpa)**

Componente\*:

Modo de Falha\*:

Causa\*:

Ação\*:

Responsável\*:

Descrição da Causa:

Ação Imediata:

Possui FCA:

Número do FCA:

**Detalhamento do Evento - Operação/Processo**

Causa Direta\*:

Causa Raiz\*:

Descrição da Causa:

Ação Imediata:

Responsável\*:

Possui FCA:

Número do FCA:



# Characterization and Detailing of Loss Events

Meus Filtros

Criar Evento

Gráficos

Relatórios

Configurações

Recolher Menu

### Lista de Eventos

Filtro +

🗑️ 🔄 📄 🔍 📄 ⏪ ⏩ Página 1 de 14 10 ▼ Eventos 1 - 10 de 134

Informações do Evento					Perda		Apontamento		
ID	Linha	Início	Fim	m <sup>3</sup>	t	AI	M	O/P	
2286	Linha 4	11/12/2016 15:37:30	11/12/2016 15:38:46	1,37	0,13	P			
2285	Linha 4	10/12/2016 16:31:25	11/12/2016 03:24:43	2662,36	260,71	✓		P	
2284	Linha 2	10/12/2016 13:32:23	10/12/2016 14:25:22	30,46	2,86	✓		P	
2283	Linha 4	10/12/2016 10:34:52	10/12/2016 10:59:50	17,19	1,68	✓	P		
2282	Linha 7	09/12/2016 07:08:37	09/12/2016 15:06:15	2055,82	208,90	✓		P	
2281	Linha 6	09/12/2016 07:07:37	09/12/2016 14:44:51	2046,08	207,91	✓	P		
2280	Linha 7	09/12/2016 04:12:24	09/12/2016 06:45:57	519,87	52,82	✓		✓	
2279	Linha 6	09/12/2016 04:10:37	09/12/2016 06:05:52	517,33	52,56	✓		✓	
2277	Linha 5	08/12/2016 09:00:02	08/12/2016 09:40:04	23,79	2,32	P			
2276	Linha 5	08/12/2016 03:06:13	08/12/2016 03:42:55	54,74	5,36	✓		P	

**Legenda das cores:**

- Evento manual
- Evento dividido
- Sub-evento (Evento proveniente de um evento dividido)



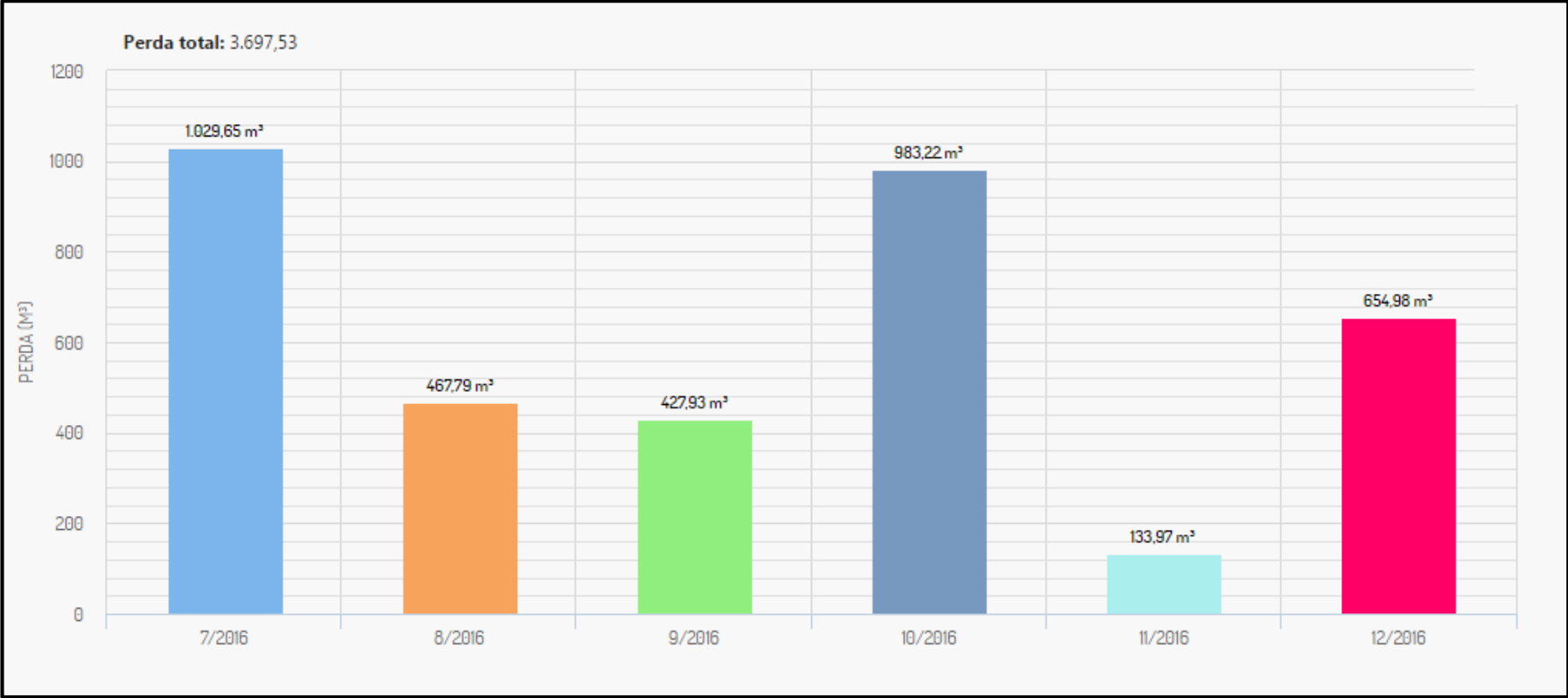
# Reports Searchinig Results

# Graphics of Loss

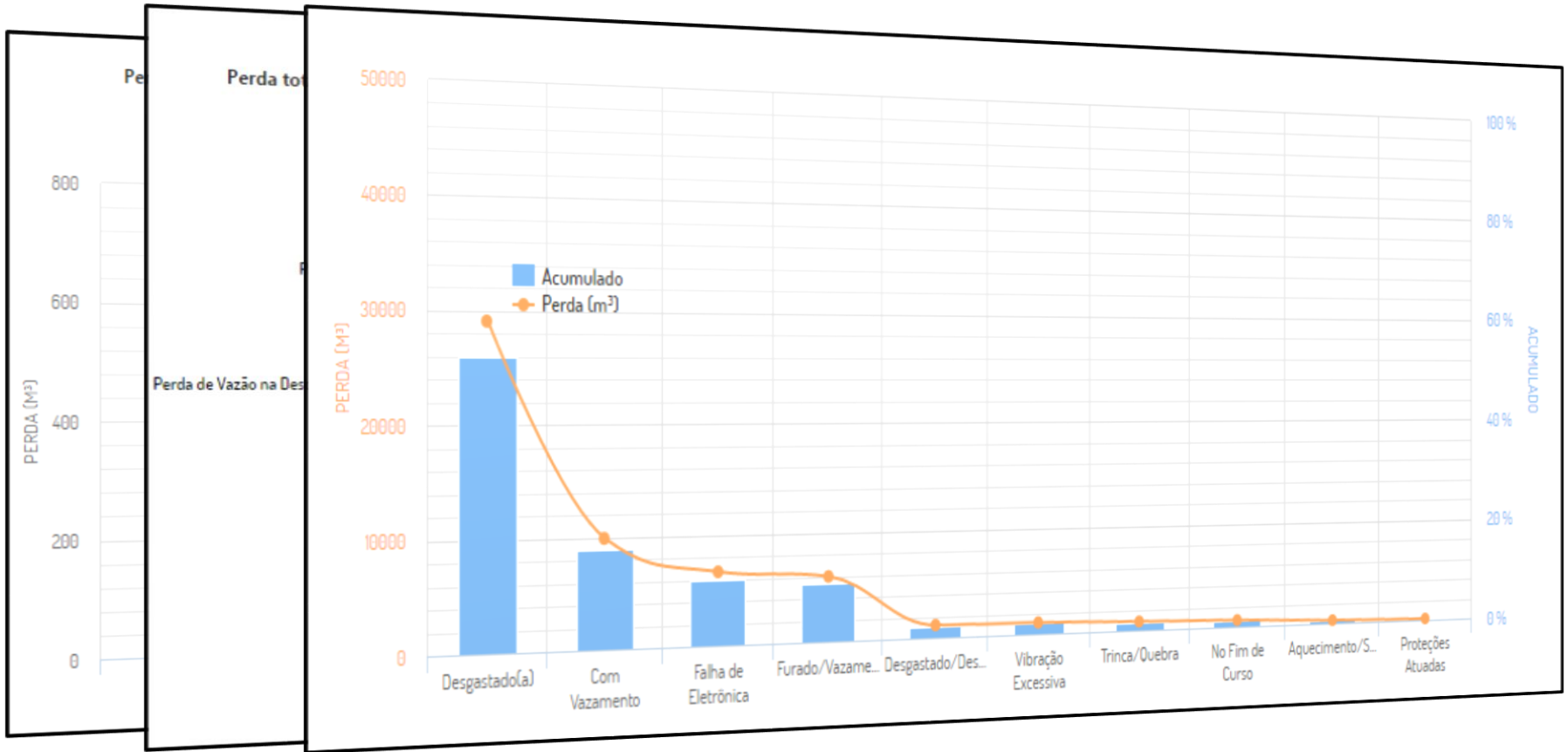
To analyze the events generated and the main reasons for losses in the 7 lines of HYDRO - Alunorte, charts were created with several different views.

These graphs allow the analysis and monitoring of the data by the board, in the near future, to act objectively and assertively in the main causes of production losses.

# Graphics of Loss



# Graphics of Loss



# Results

- After only six months of the implementation of the system, results can already be observed. Higher reliability of information on the causes of production losses and immediate availability of data.
- More than 1.000 generated events
- More than 40.000 elements in AF
- Hundreds of engineering hours saved



# Conclusion and Vision for the Future

# Leveraging the PI System in Production Loss Control

## COMPANY and GOAL

HYDRO Alunorte is the world's largest alumina refinery and needs maximum efficiency in data generation and analysis.



## CHALLENGE

Reduce spent engineering hours in information consolidation and map the main causes of loss of production.

## SOLUTION

The PI System was used to monitor the production loss in real time and generate events for direct engineering performance.

## RESULTS

High data availability has been achieved new levels of efficiency through rapid reconciliation of data, in addition, hundreds of engineering hours has been saved.



# Conclusion

Since the idea of the system was born, much can already be observed in the treatment culture of loss. The concept of loss event handling has been improved, the information has become more accurate and reliable, and a significant increase in process efficiency.

This system opened doors and started a new phase in the Alunorte HYDRO treatment for the [PI System](#) and its versatility.

# Vision for the Future

The next steps for the system involve the mapping of the main causes of production loss and mainly in the reduction of the impacts of these causes, resulting in a significant increase of production of the plant.

Strategies for involving other process variables and other **PI Server** tools are already being developed in order to maximize the results that the **PI System** has to offer.

## Questions

Please wait for the **microphone** before asking your questions



State your **name & company**

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# Thank you!



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**Automation and Systems Technician**



## **LYNX Process**

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