AVEVA PI WORLD

The Digital Transformation of Jirau Hydropower plant operation through PI System deployment at Jirau Plant

Joint R&D project between Jirau Energia and UNIFEI

Presented By: Mateus Santos

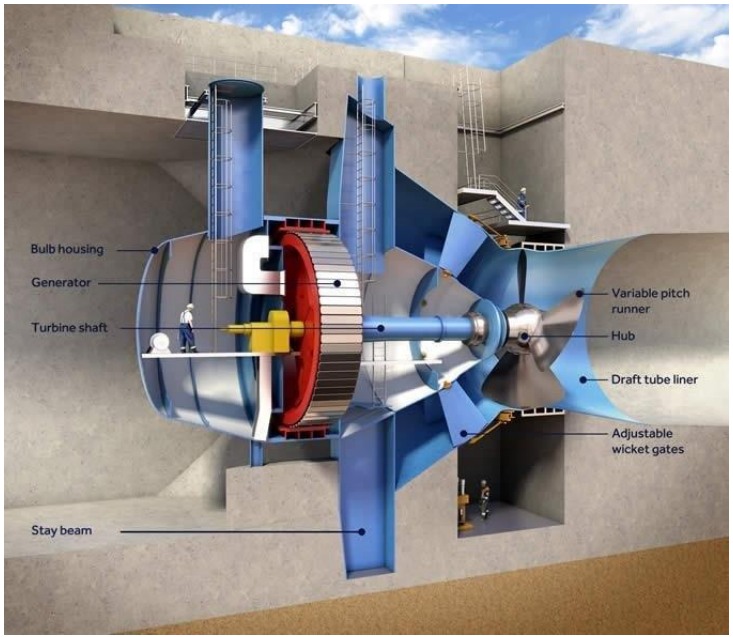
About JIRAU Energia

Jirau Hidrelectric Power Plant

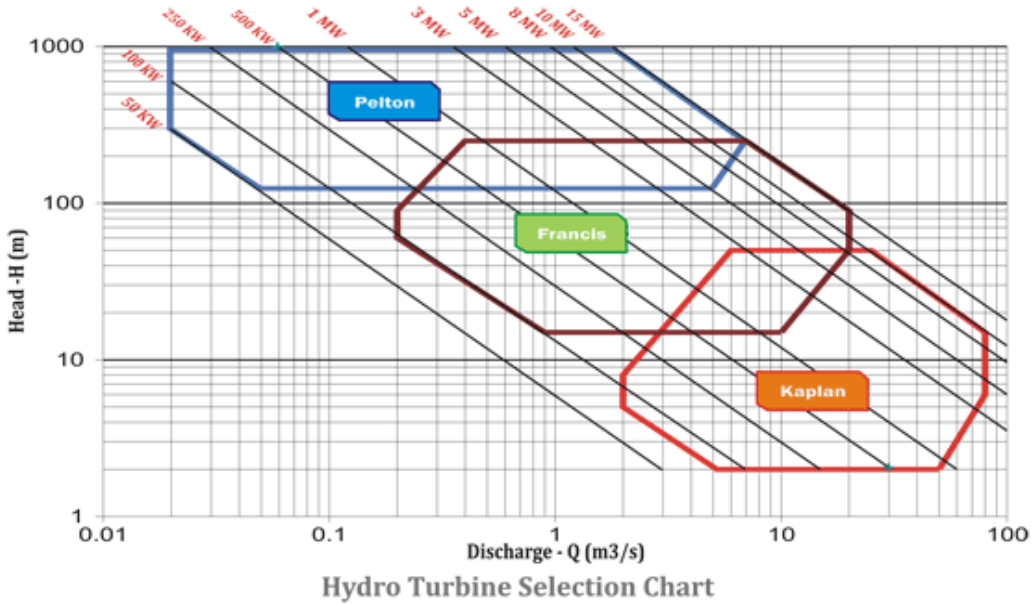
- Run-of-river operation located at Madeira River Basin, 100km from Porto Velho, Rondonia State capital.
- 50 bulb turbines (75MW each), totalizing 3750MW installed capacity.
- 4th biggest hydropower plant in Brazil (capacity) and biggest in the world (generator units).

What is a bulb turbine?

Kaplan turbine with bulb rotor propeller



Source: Yates, N., and B. Tatlock. "Optimising tidal lagoons." *Proceedings of the European Wave and Tidal Eenergy Conference*. 2017.



Source: EDCL Group website. LINK

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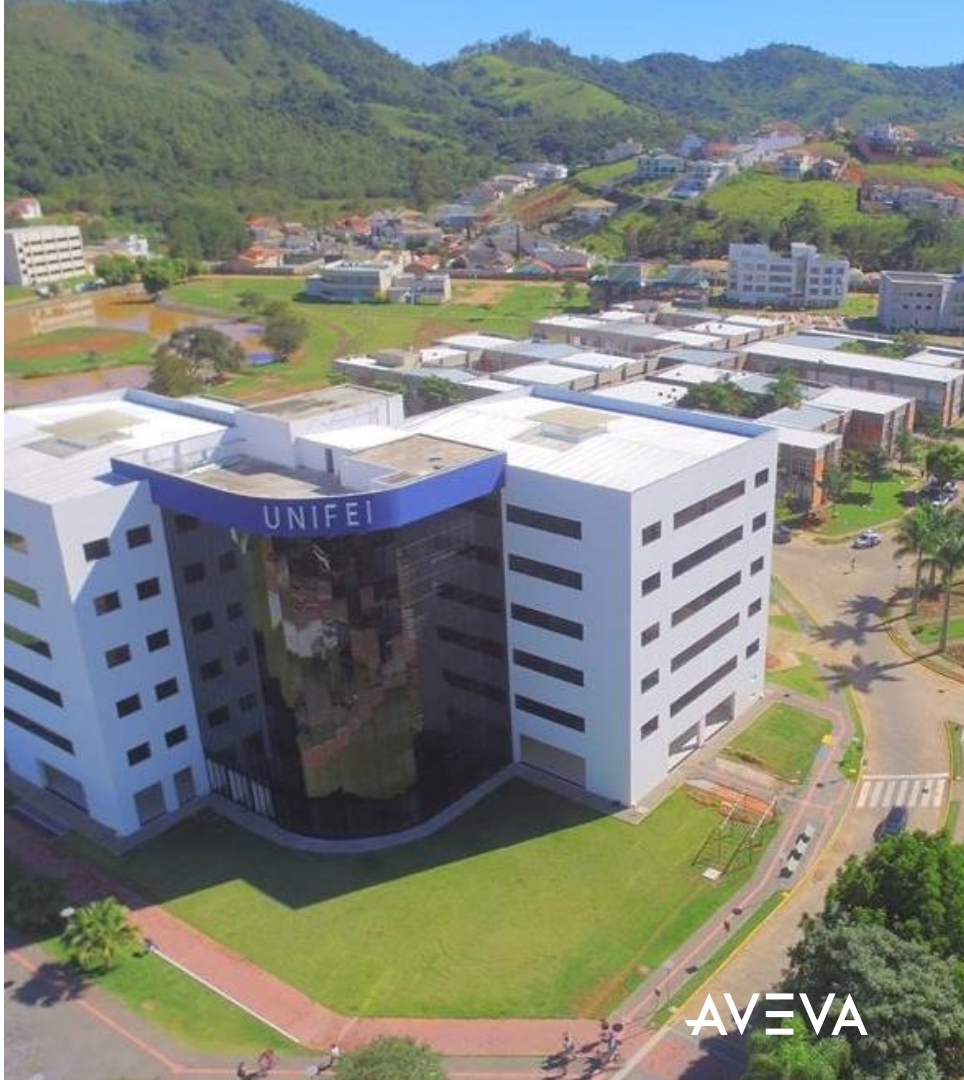
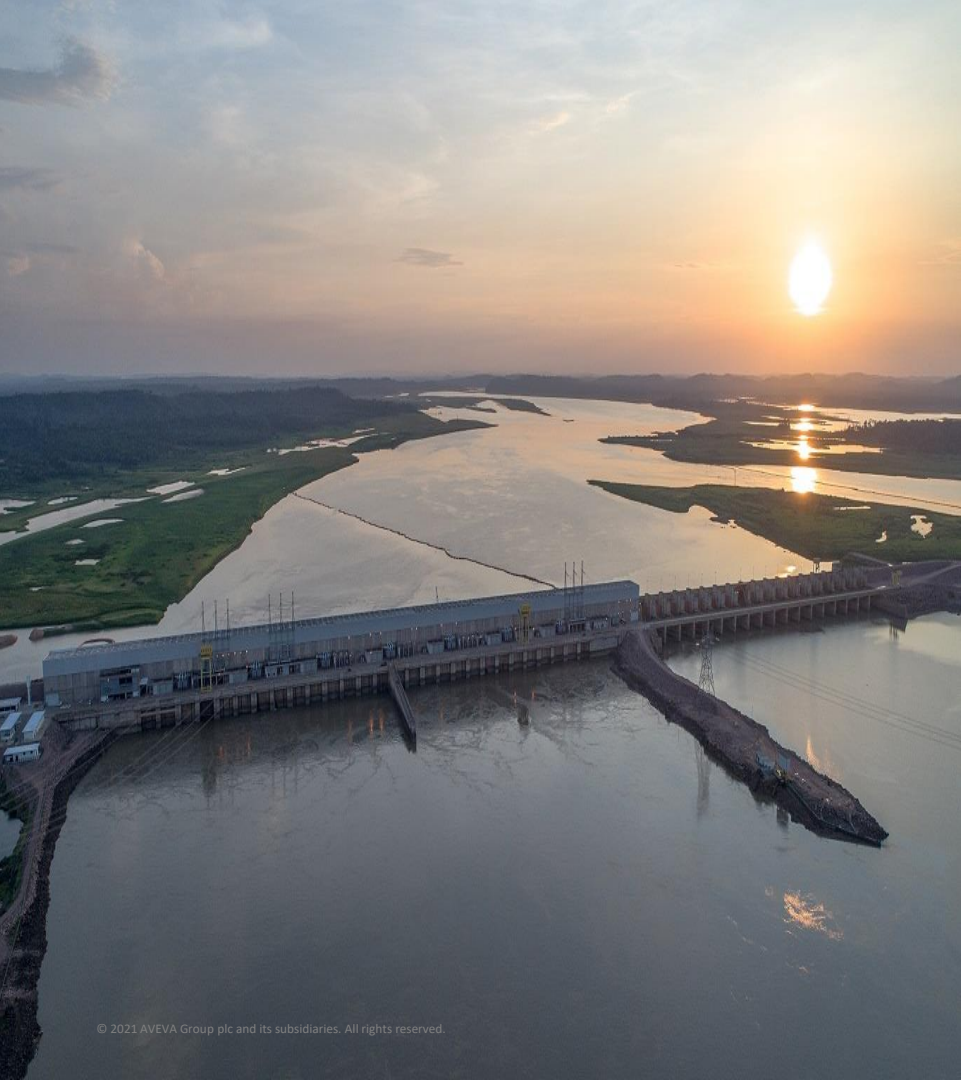
About UNIFEI

Federal University of Itajubá

- Located in Itajubá, Minas Gerais (MG) and it is a centenary university with strong ties to the power market.
- Nearly 6500 undergrad students and 1000 grad students.
- 1st Federal university from MG state at the Latin America 2020 Times Higher Education Ranking.





The challenges to be faced

What were the operation overview and its issues?

- *Limited accessibility to historical data* – The operation data was stored solely on SCADA software, resulting in slow searches for historical data.

- *Power scheduling* – Operations engineers had to gather data from different systems in order to successfully plan the scheduling for the following days.

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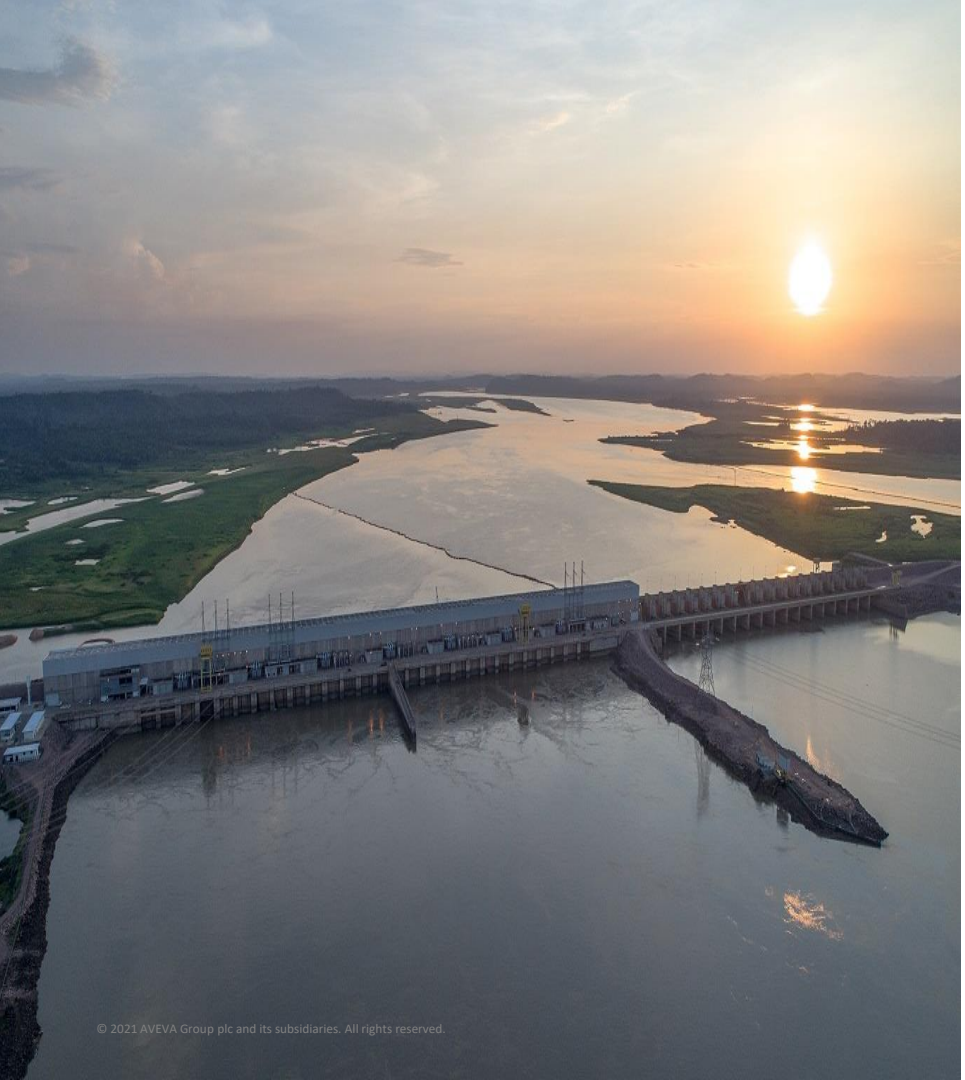
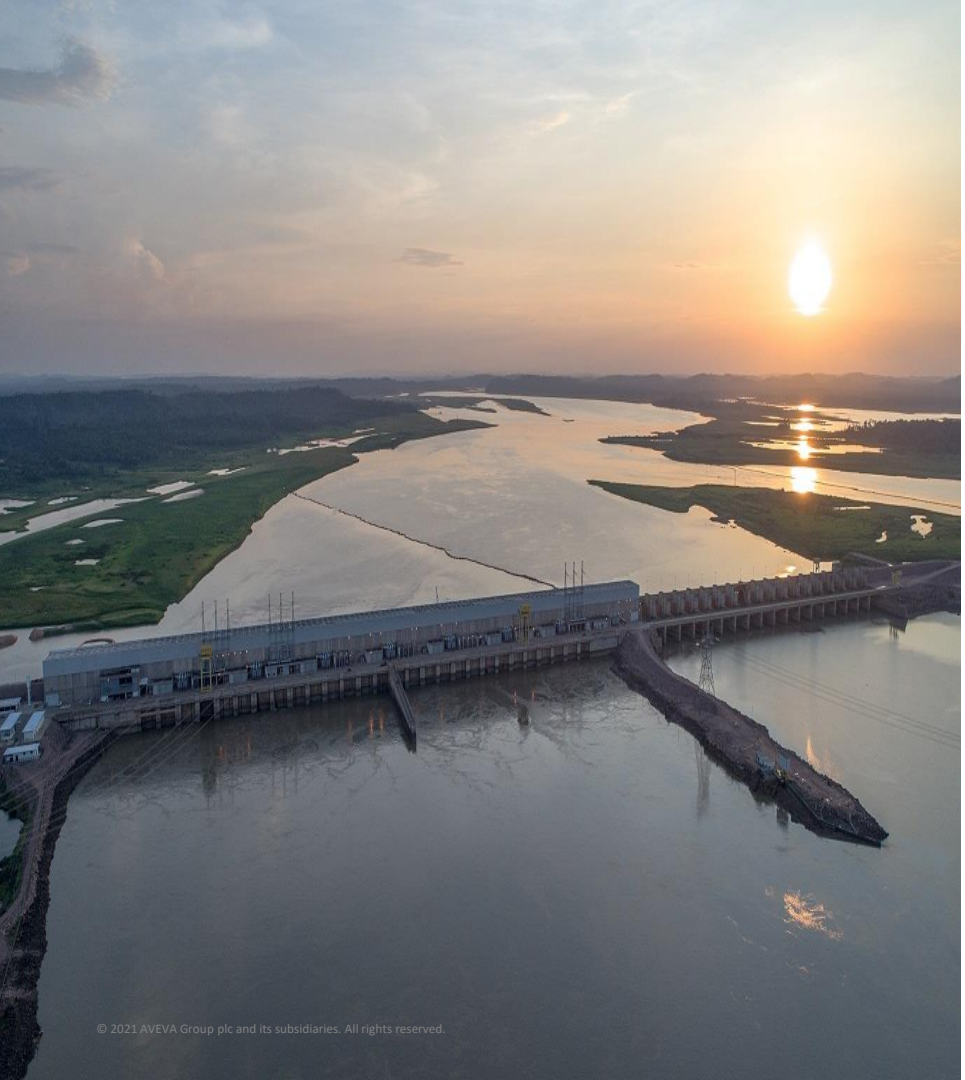


The challenges to be faced

What were the operation overview and its issues?

- *Operating status determination* – Operators had to manually totalize status information of all turbines and generators hourly.

- *Hydrologic data calculation* – An employee should input data in different systems in order to generate hourly data concerning the hydrologic resources available to the plant.



The challenges to be faced

What were the operation overview and its issues?

- *Power Dispatch*
  - Operators used data from different curves and spreadsheets to assess the best plant configuration.
  - Hard to analyze the real impacts of material carried by the river flow to the water intakes.
  - Limited time to make critical decisions and absence of effective tools to analyze alternative configurations.

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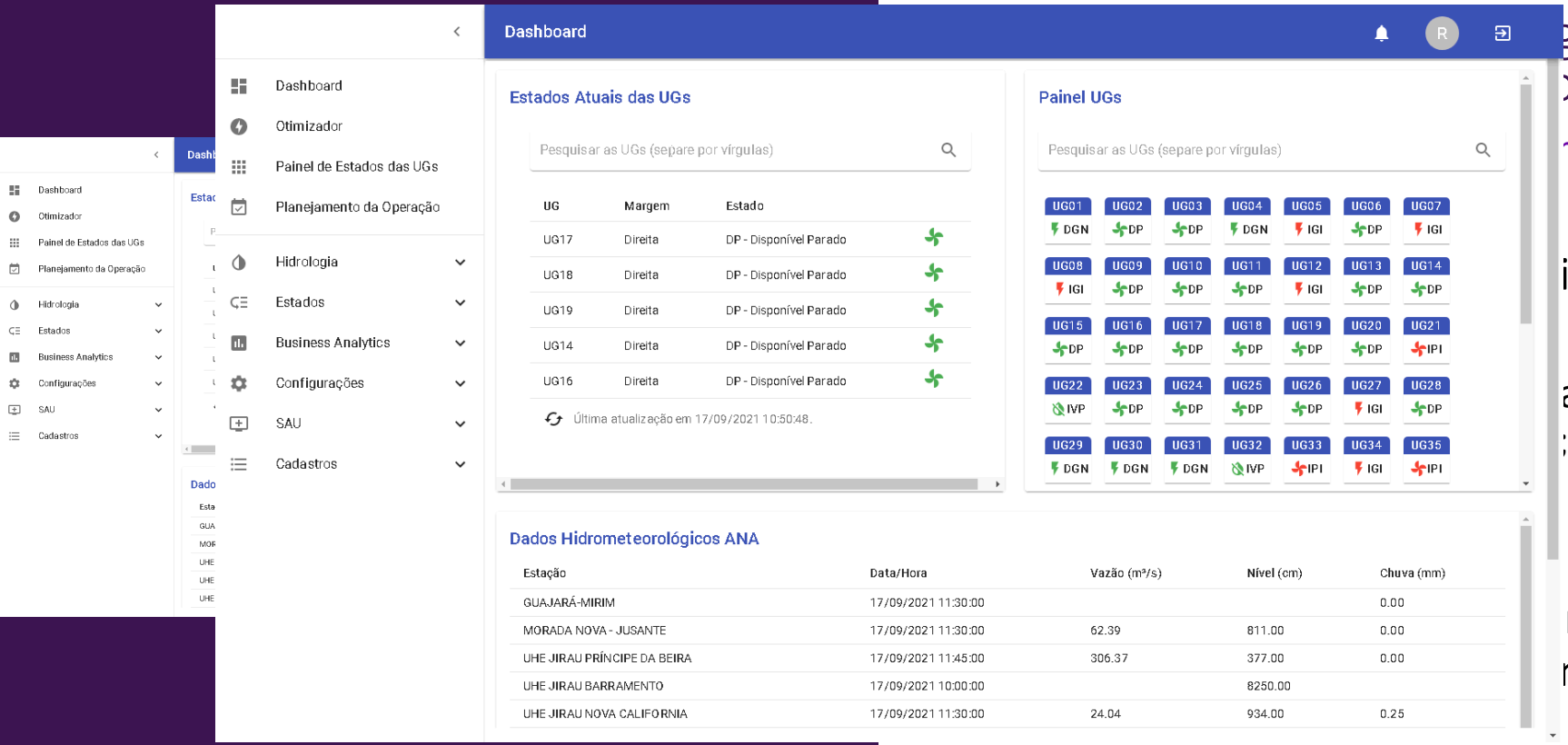
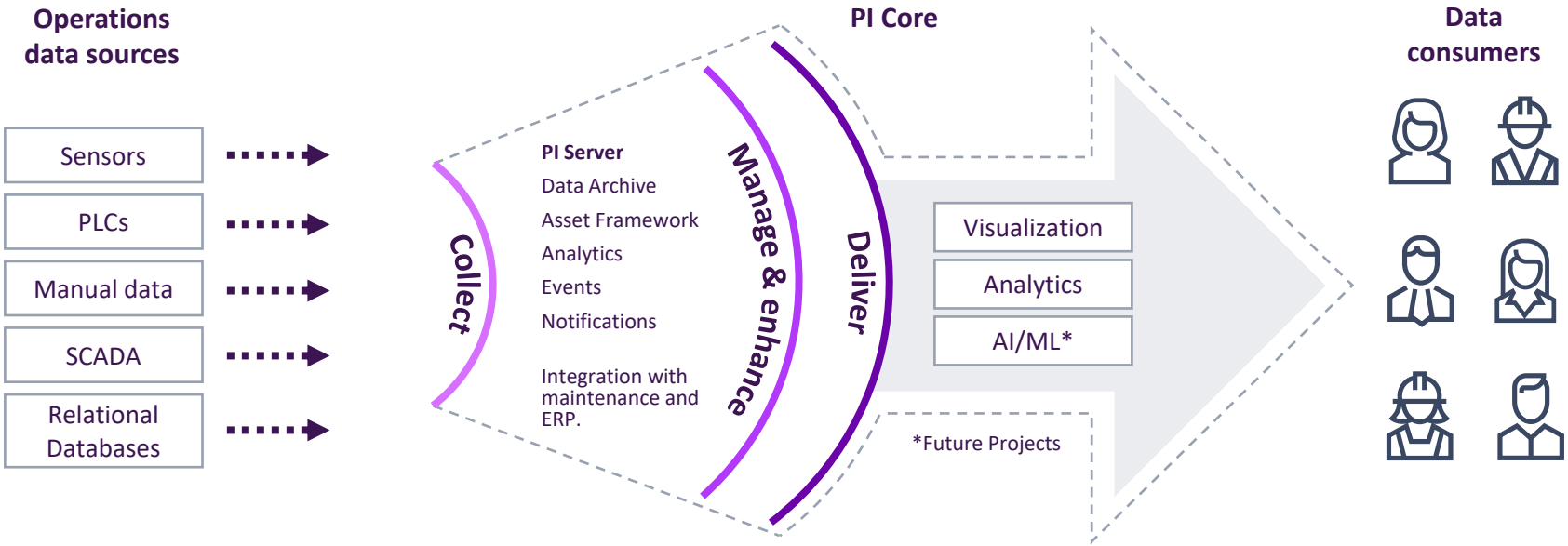


Using the PI System to leverage the plant digital transformation

Development of the optimization platform

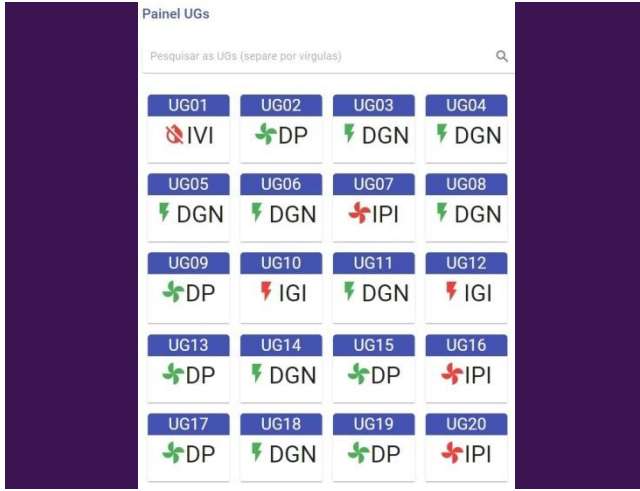


Using the PI System to leverage the plant digital transformation

What did PI System help us achieve?

- *Data accessibility* – The PI AF infrastructure allowed easy access to historical and real-time data at different company levels. In order to help the development process, a mirror PI Server was created in UNIFEI premises using scripts for data dumps.

- *Operating Status* – Using the PI Web API, an application was developed to automatically detects status changes by monitoring key attributes. This app saves a considerable amount of operators time.

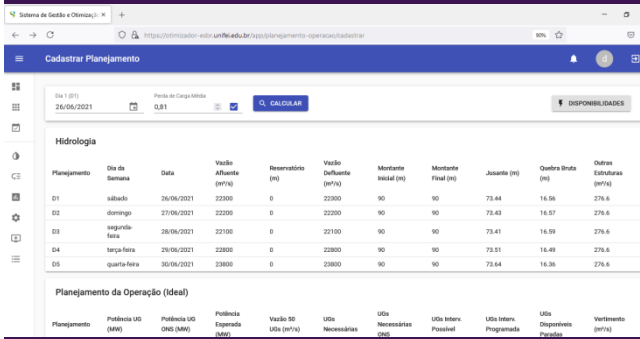


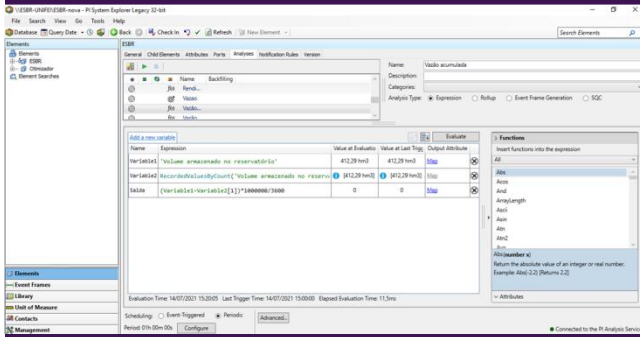
Using the PI System to leverage the plant digital transformation

What did PI System help us achieve?

- *Power Scheduling* – a web application was developed to gather all real-time and other systems data required to schedule the power generation for the following days. The app automatically generates a schedule, and operators need only to validate it.

- *Hydrologic data* – the data used by operators to calculate the hydrologic resources was transformed in polynomials and deployed through PI Analytics and then sent to different company systems.



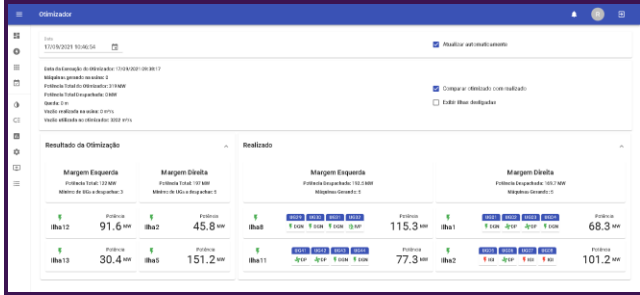


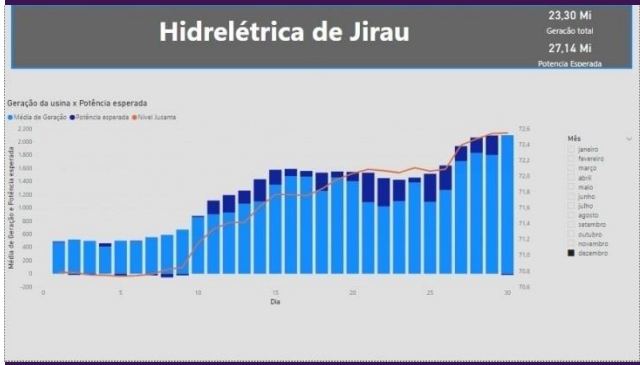
Using the PI System to leverage the plant digital transformation

What did PI System help us achieve?

- *Power dispatch* – Real-time operation data is collected from PI System and inputs an Optimization System using AI techniques to determine the best plant configuration to achieve the best yield possible.

- Data analysis – To allow the processing of PI System altogether with other company data, an application using Apache Spark for Big Data processing was developed, and only consolidated data is sent to BI tools.





What did we learn, and what's next?

PI System was a catalyst of the digital transformation

- AVEVA PI System played a key role in the development, providing the required tools to empower the optimization platform

- Currently, we are working on collected data to detect impactful insights about the operation that might lead to better planning or real-time decision making

- We also are improving the optimization models by studying the data from equipment operation and the impacts of material transportation through the river flow

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Optimization of Jirau Hydroelectric Power Plant operation

JIRAU ENERGIA

UNIFEI

Challenge

Automate and optimize critical processes in the plant operation, developing a platform to determine the best possible plant configuration.

Provide tools to help decision making while reducing employees “spreadsheet” workload.

Solution

Develop a platform through AVEVA PI System deployment to leverage the automation and optimization processes.

The application uses PI AF, PI Vision and PI Web API.

Benefits

Increased power generation and operational efficiency, reduced costs.

Improved data accessibility, reduced “spreadsheet“ workload and accelerated time-to-value for Analytics.

Infrastructure for future Machine Learning projects.

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“AVEVA PI System plays a key role in the digital transformation and optimization solutions for Jirau Hydropower Plant operations.”

Marcelo Fonseca, Jirau Hydropower Plant Operations Manager

Mateus Gabriel Santos

PhD Student and Researcher

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