



## Use of GPA Synchrophasor Products at ONS

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ONS, Brazil

GPA Synchrophasor User's Group  
October 24-25th, 2024  
Richmond, USA

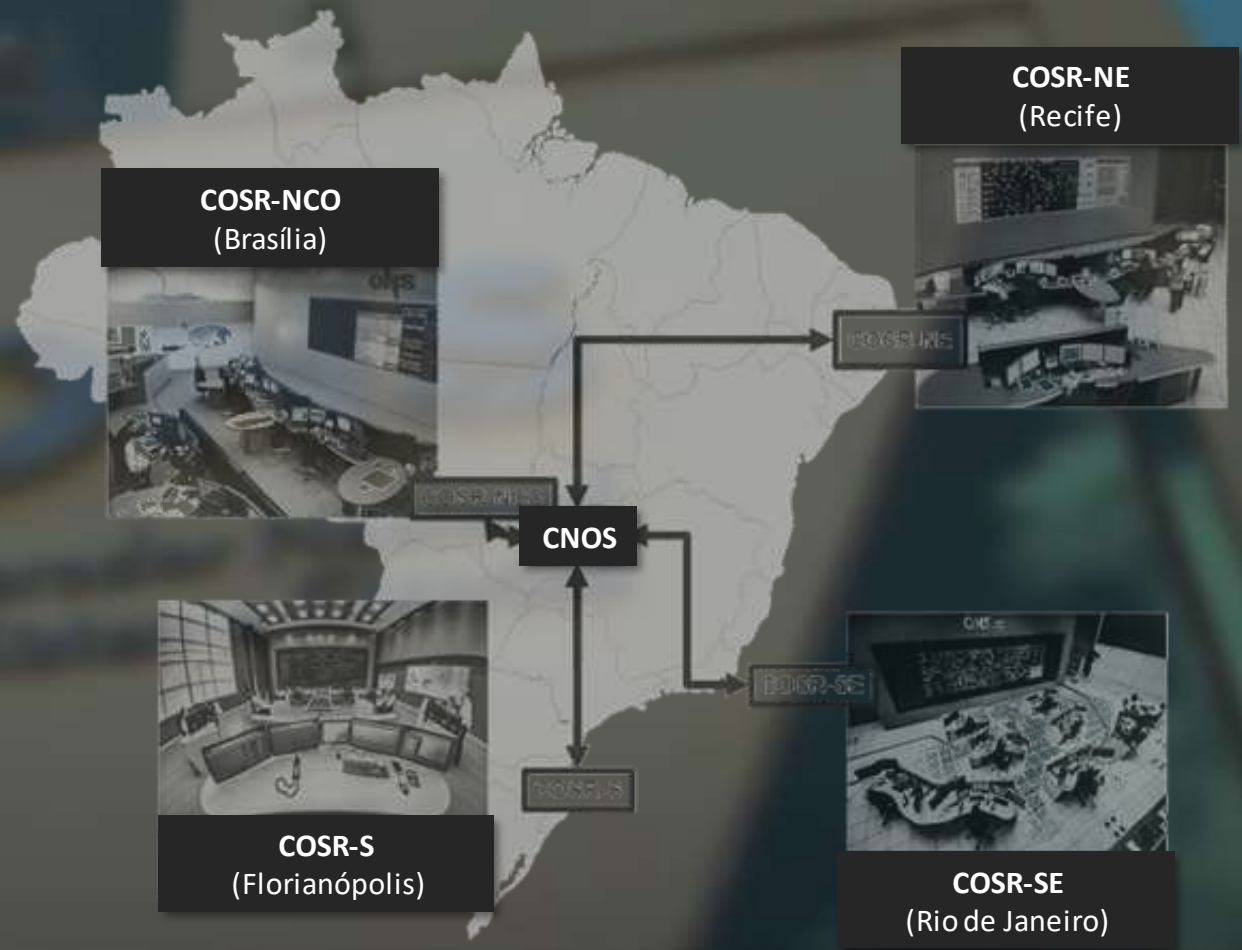
# About ONS

[www.ons.org.br](http://www.ons.org.br)

## We are the National Electric System Operator - ONS

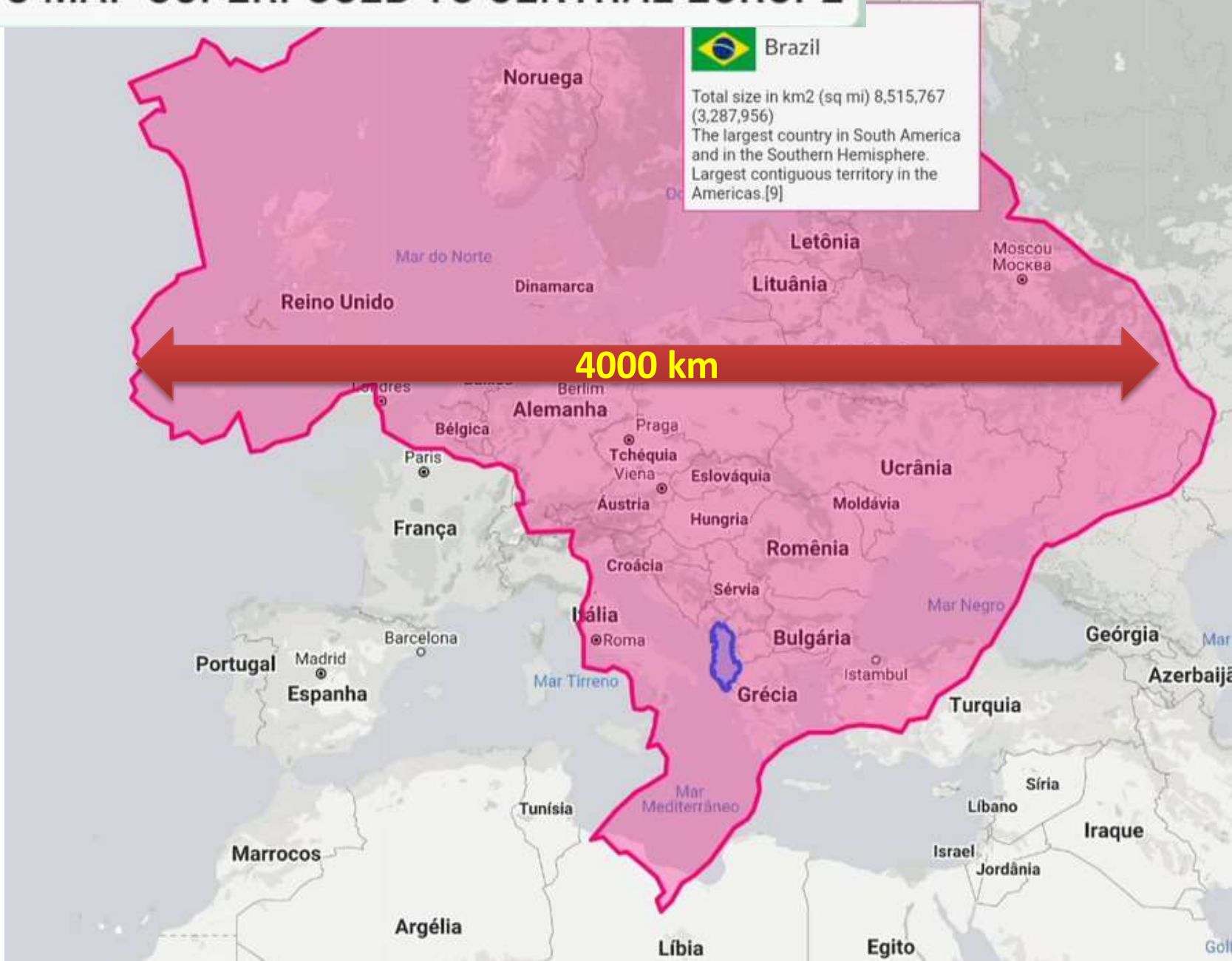
The mission of ONS is to ensure the supply of electricity in the country, with quality and a balance between safety and the overall cost of operation.

The ONS is a private law legal entity, non-profit, under government's regulation and supervision. ONS does not own any generation, transmission, or distribution assets. The centralized management of the system operation guarantees operational security at the lowest possible cost.



# HOW BIG IS BRAZIL?

## BRAZIL'S MAP SUPERPOSED TO CENTRAL EUROPE



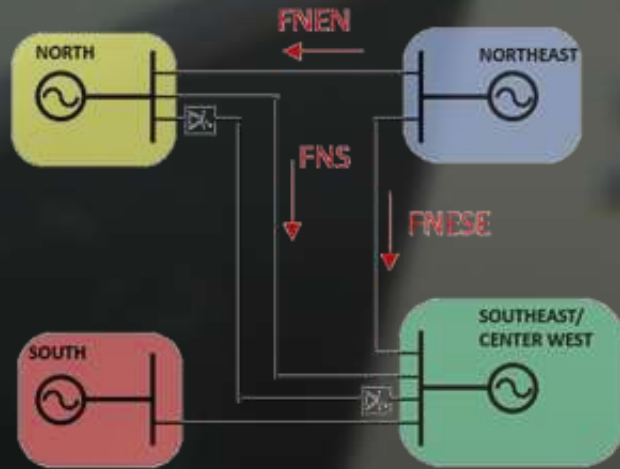
# ONS in numbers

[www.ons.org.br](http://www.ons.org.br)

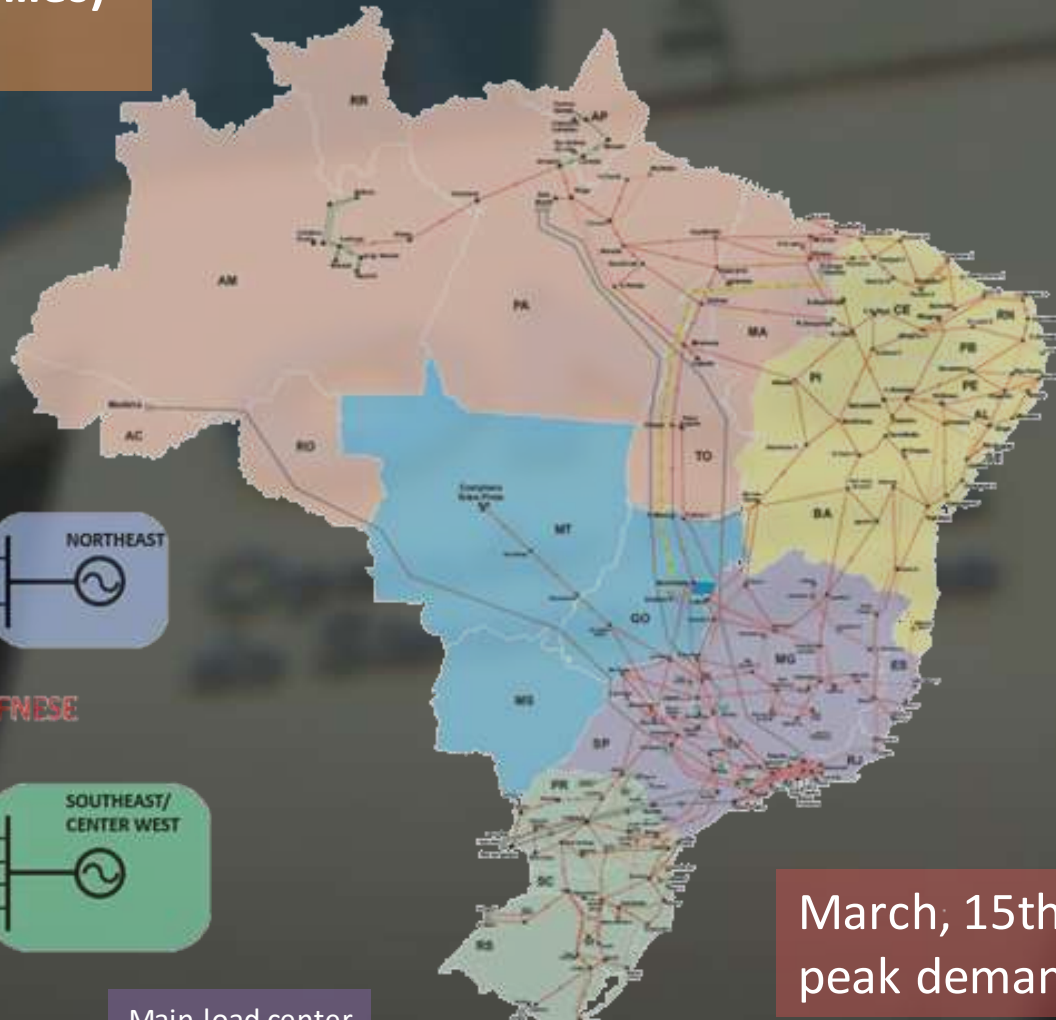
Complex Hydro-Thermal-Renewable Generation grid

200 000 km(124,000 miles) transmission lines

Large run-of-river hydropower plants far from load centers at the North (Seasonal Energy)



Main load center in Southeastern Brazil



# GO15

One of the world's largest synchronous networks



|         |         |
|---------|---------|
| 2024    | 2028    |
| 12.1 GW | 21.1 GW |

Rapid increase of wind and solar Generation (Northeast Region)



|         |         |
|---------|---------|
| 2024    | 2028    |
| 29.4 GW | 35.2 GW |

March, 15th 2024: highest peak demand of **102 GW**

# Synchrophasors at ONS

2025: Advanced applications, alarms, simulation and more

## Studies Phase

**2005**  
Technical studies of the technology

**2009**  
PMU vendor's certification process

**2006/2008**  
Technical specification for the future production system

## Tendering Phase

**2012**  
Telecom technical specification

**2011**  
MME/BI RD Funding Research

**2013**  
PDC Infrastructure Technical Specification

**2015**  
Bidding Process Analysis from ONS Team

## CC-PMS (GE)

**2019**  
Production of the CC-PMS

**2017**  
GE Grid Solutions Bidding Process Winner

## openWAMS (GPA)

**2024/ may**  
openWAMS (Phase One) enters in production

**2023 /out**  
Management decision opting in a alternative solution based on open-source platform.

# openWAMS: A Cost-Effective and Flexible Solution

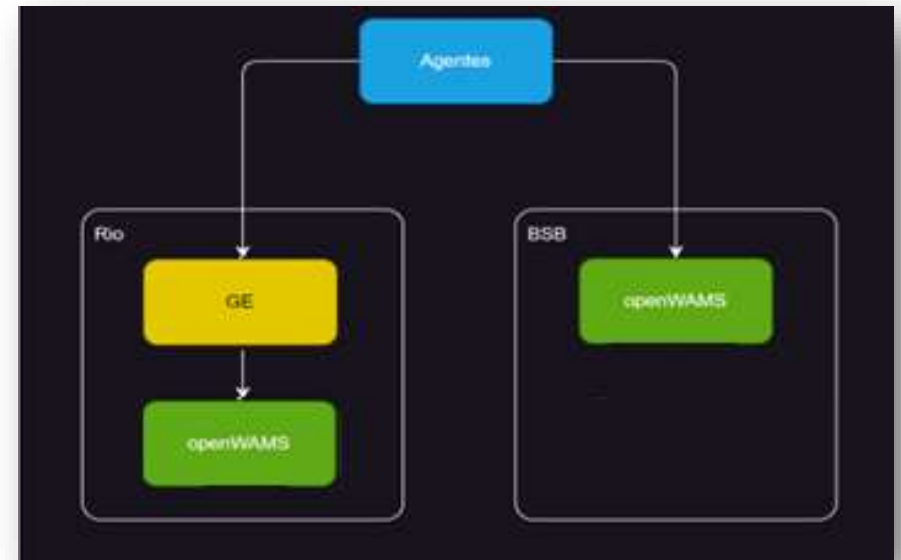
- **Problem:** End-of-contract for CC-PMS system necessitated a new, modern and cost-effective solution.
- **Solution:** Adopted GPA solution, leveraging previous experience with openPDC/Historian. Contract signed with GPA for SLA, training and technical support.
- **Benefits:** Aligned with Grafana for a flexible and customizable interface. Initially designed as a short-term solution but quickly gained traction and became the long-term choice. Open-platform approach (hence the name: openWAMS) for scalability and customization.
- **Achievements:** Phase One implemented in just 7 months with good user's feedback (recording breaking time!), reusing existing hardware. Phase Two under development, focusing on advanced real-time applications and database automation.



|                        |                 |                |
|------------------------|-----------------|----------------|
| Anna Carolina Meireles | Janio Los       | Ricardo Lira   |
| Victor Freiria         | Marcio Brasil   | Rafael Vilar   |
| Fábio Eloy             | Arthur Mouco    | Paulo Quintão  |
| Rafael Waddyngton      | Cesar Rodrigo   | Hector Volskis |
| Marcelo Cascardo       | Demetrius Silva | +++            |

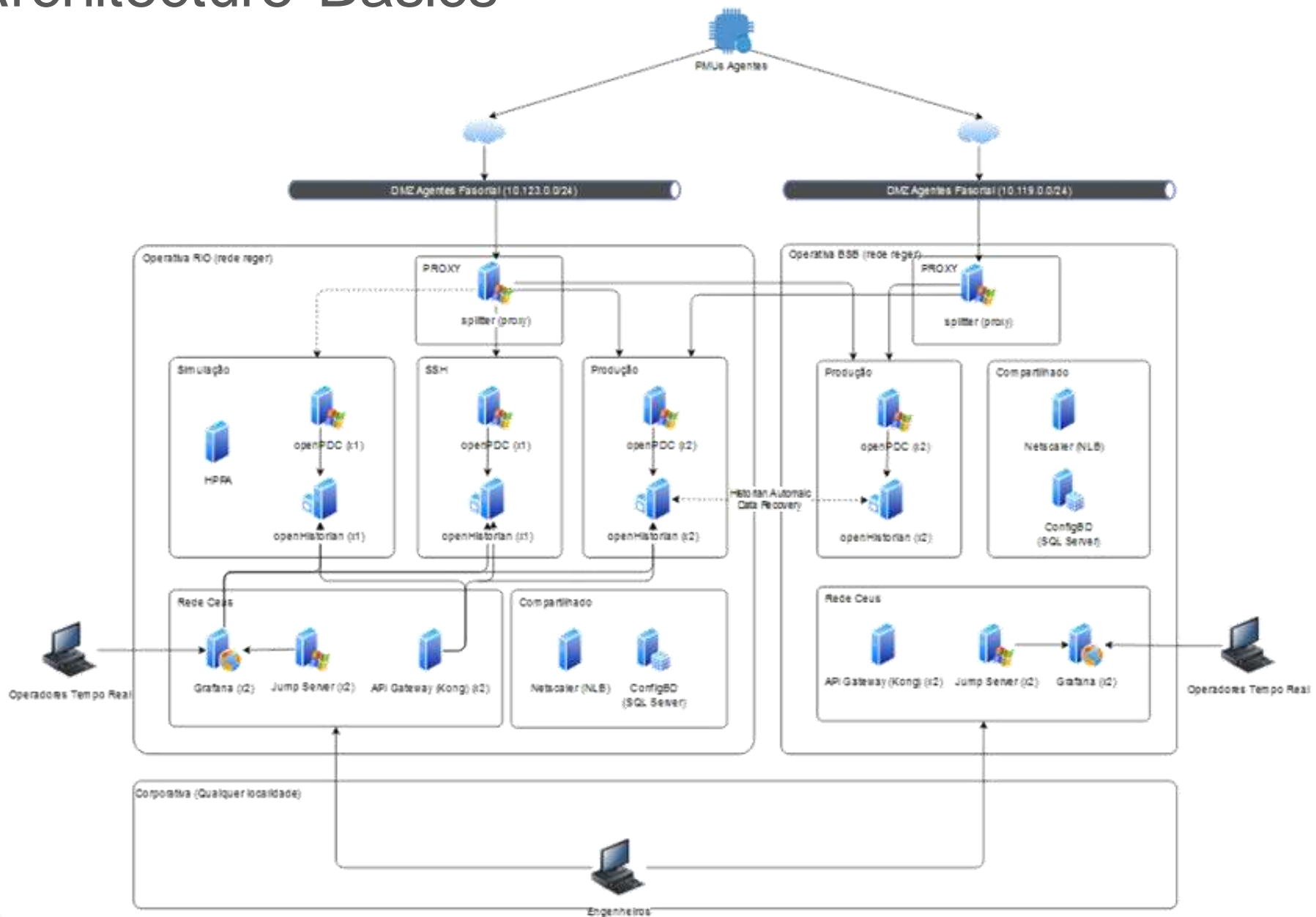
# Environments Design

- Redundant critical production systems:
  - **OP-RIO** (Rio de Janeiro): operational
  - **OP-BSB** (Brasília): under commissioning
- Scalability: Designed for up to 1500 PMUs (currently receiving 600 @ 60 FPS, 3-phase V/I).
- Comprehensive Support Environments:
  - **CORP**: Corporate user access for historical data analysis
  - **DEV**: Development environment for in-house application creation
  - **SIM**: Simulation environment (HPPA OTDS) for system validation and training
  - **LAB**: "all-you-can-break" laboratory for testing, expository learning, and Grafana editor training
- Grafana visualization UI: comprehensive dahsboards portfolio for control room operations, post-operation activities, and system maintenance.
- Advanced applications in operation and under-development, including alarm management.



| ID     | Objetivo                                | Criticidade |
|--------|---|-------------|
| OP-RIO | Operação do Sistema                     | ALTA        |
| OP-BSB | Operação do Sistema                     | ALTA        |
| CORP   | Acesso Geral Corporativo                | ALTA        |
| DEV    | Desenvolvimento Aplicações e Dashboards | MÉDIA       |
| SIM    | Simulação, Treinamento e Homologação    | BAIXA       |
| LAB    | Laboratório de Testes Livres            | BAIXA       |

# Architecture Basics





# In-house Development Applications

Based on the data integration with openHistorian via STTP/Python API

In-house application can be developed according to ONS needs, harvesting the staff power system expertise.

## In-production applications:

- PMU Data Quality Ranking

## Under development:

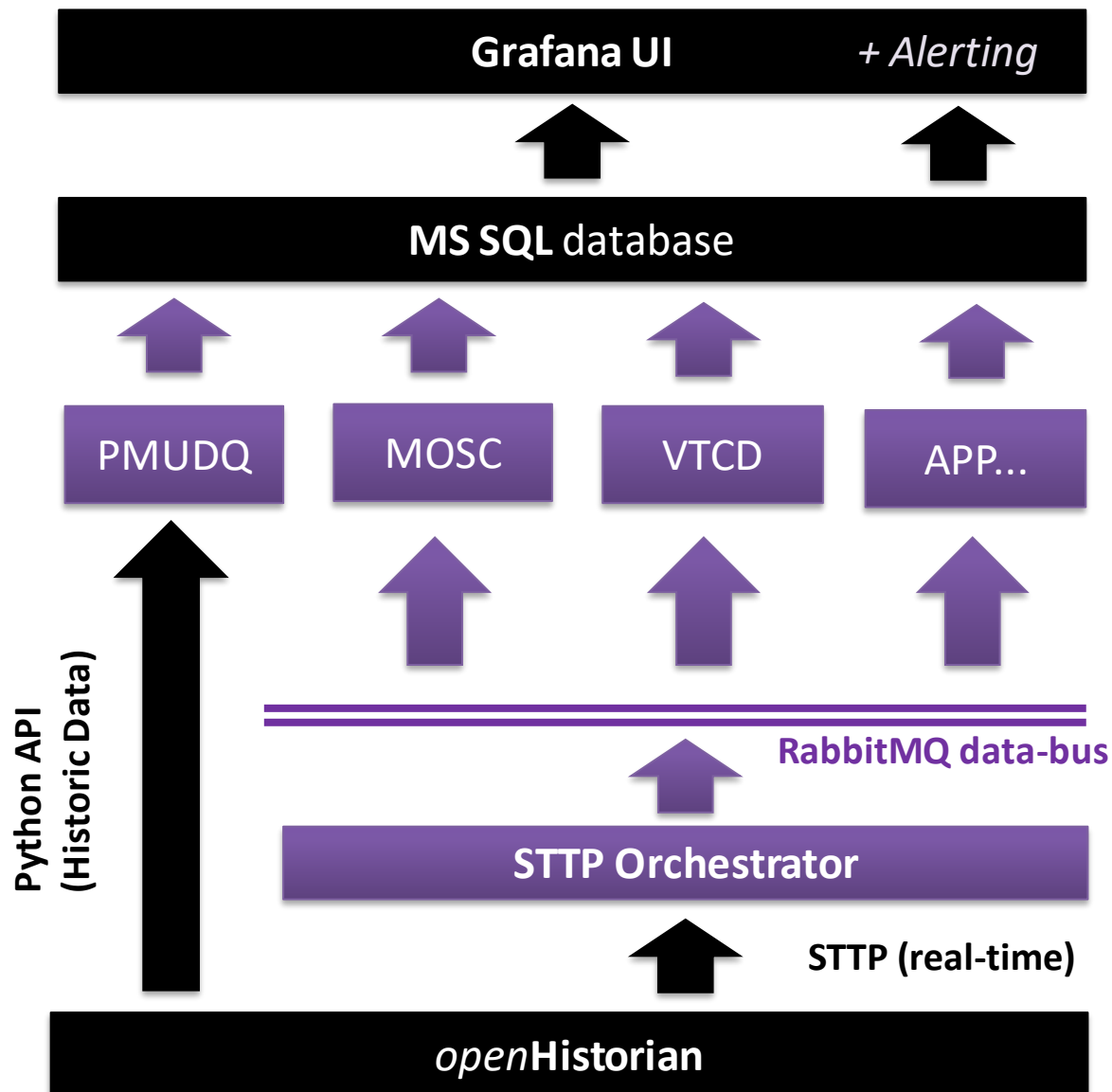
- Oscillation Monitoring
- Energy Quality Monitoring
- PMU Angle Constraints Monitoring (integrated with DSA)

## Planned:

- Disturbance Localization
- Islanding Detection and Re-synchronization

## Current challenges:

Currently exploring the best approach to guarantee stability in the STTP flow in order to make highly scalable up to 500 analytics.



# Leveraging Grafana for Powerful Visualization

Grafana enables modern, flexible and highly customizable platform for dashboard creation. Real-Time/Historic combined.

openWAMS uses an independent Grafana server enabling more flexible and customized deployment. GPA openHistorian connected via openHistorian Data Source plugin.

Grafana community provides several plugins for advanced panels creation, enabling continuous UX enhancement.

ONS' users provided excellent feedback (friendly navigation, easy to access data and modern design).



# Dashboards Portfolio

## [A] Control-Room Operation

- Geographical/Navigation View
- Real-Time/Historic Trending
- Short-Circuit Analysis
- Islanding and Resynchronisation (\*)
- Electromechanical Oscillation Monitoring (\*)
- Events & Alarms Registry (\*)
- Harmonics Monitoring
- System's Situation Awareness
- Energy Quality Assessment (\*)

## [B] System Administration

- PMU Data Quality (\*)
- Multi-site Data Quality Report (\*)
- Users Monitoring
- openHistorian Health Monitoring



\* powered by ONS in-house developments (GPA/Python APIs)

# Geographical/Navigation View

2024-10-08  
15:45:03

Frequência Local  
60.00 Hz

SIN: Frequência COS/Local/REGER

Visão Geográfica | SIN Maps

Ref: MTJU\_500\_PM\_02

PMUs 7

- ▶ LT SAMUEL/ARIQUEMES C3 [ROSM\_230\_PM\_10]
- ▶ LT SAMUEL/PORTO VELHO C3 [ROSM\_230\_PM\_09]
- ▼ BA 2 SAMUEL [ROSM\_230\_PM\_08]

|             |  |
|-------------|--|
| Name        | BA 2 SAMUEL [ROSM_230_PM_08]                       |
| Equipamento | BA 2 SAMUEL  |
| Latitude    | -8.75  |
| Longitude   | -63.5  |
| Acronym     | ROSM_230_PM_08                                     |
| Agente      | ENT  |
| Qualidade   | 1-Confiaavel                                       |
| Link        | <a href="#">Medidas PMU local (painel lateral)</a> |
| Link        | <a href="#">Definir Ref. Angular</a>               |

- ▶ BA 1 SAMUEL [ROSM\_230\_PM\_07]
- ▶ LT SAMUEL/PORTO VELHO C2 [ROSM\_230\_PM\_06]
- ▶ LT SAMUEL/PORTO VELHO C1 [ROSM\_230\_PM\_05]
- ▶ LT SAMUEL/ARIQUEMES C1 [ROSM\_230\_PM\_04]

PMU Local: Balanço da Tensão Trifásica (NOM) [LT MIRACEMA/BARR...]

525.0 kV
526.8 kV
522.0 kV

FASE A
FASE B
FASE C

PMU Local: Tensão Trifásica (NOM) e Reativo [LT MIRACEMA/BARREL...]

| Name   | 15:42:40 | 15:42:45 | 15:42:50 | 15:42:55 | 15:43:00 |
|--------|----------|----------|----------|----------|----------|
| FASE B |          |          | 526.8 kV | 527.0 kV | 526.8 kV |
| FASE A |          |          | 525.0 kV | 525.3 kV | 525.0 kV |
| FASE C |          |          | 521.8 kV | 522.2 kV | 522.0 kV |

PMU Local: Corrente Trifásica e Potência Ativa [LT MIRACEMA/BARR...]

| Name   | 15:42:40 | 15:42:45 | 15:42:50 | 15:42:55 | 15:43:00 |
|--------|----------|----------|----------|----------|----------|
| FASE A |          |          | 837.3 A  | 843.5 A  | 841.9 A  |
| FASE C |          |          | 817.3 A  | 823.7 A  | 823.1 A  |
| FASE B |          |          | 792.8 A  | 798.8 A  | 797.6 A  |

Diferença Angular (PMU Local - Referência)

QUAL

1-Confiaavel
4-Indisponivel
3-Ruim
2-Suspeita

# Live/Historical Trending

GRÁFICO DE TENDÊNCIA

Ambiente: [RIO-1 PROD] Qual:[1-Confíavel] COS:[All] KV:[All] KV:[All] Agente:[All] PMU:[BABRD\_500\_PM\_02 + CETGD\_500\_PM\_05] Tipo:...

4.00 kA 68.00 Hz

Incluir Enter variable value

COS

Agente KV

(0/0 selected)

All

CNOS

COSR-NC0

COSR-NE

COSR-S

PMU

Tipo

(2/323 selected)

Search values

All

AMJA\_69P0\_PM\_01

AMTA\_69P0\_PM\_01

BABJD\_500\_PM\_05

BABRD\_500\_PM\_01

BABRD\_500\_PM\_02

BABRD\_500\_PM\_03

BABTR\_500\_PM\_01

BABTR\_500\_PM\_02

BABTR\_500\_PM\_03

BABTR\_500\_PM\_06

GRÁFICO DE TENDÊNCIA

Ambiente: [RIO-1 PROD] Qual:[1-Confíavel] COS:[All] KV:[All] KV:[All] Agente:[All] PMU:[All] Tipo:[FREQ] Nmax:[5]

2024-10-03 10:42:44

- ONS\_SPSTIN\_500\_PM\_02.FREQ 60.01 Hz
- ONS\_PRODL\_525\_PM\_01.FREQ 60.01 Hz
- ONS\_PRIVP\_525\_PM\_08.FREQ 60.01 Hz
- ONS\_SPSTCH\_500\_PM\_04.FREQ 60.01 Hz
- ONS\_MGJGSE\_500\_PM\_03.FREQ 60.01 Hz

- ONS\_MGJGSE\_500\_PM\_03.FREQ
- ONS\_PRIVP\_525\_PM\_08.FREQ
- ONS\_PRODL\_525\_PM\_01.FREQ
- ONS\_SPSTCH\_500\_PM\_04.FREQ
- ONS\_SPSTIN\_500\_PM\_02.FREQ

FA RESULTANTE [18 medidas]

ListaResultante (18/18 selected)

All

ONS\_CETGD\_500\_PM\_05:LTSETS\_V9\_FV\_A\_VA\_500.MAG

ONS\_CETGD\_500\_PM\_05:FREQ

ONS\_BABRD\_500\_PM\_02:LTBAR\_E\_N5\_FV\_P\_V1.MAG

ONS\_CETGD\_500\_PM\_05:LTSETS\_V9\_FV\_P\_V1.MAG

ONS\_CETGD\_500\_PM\_05:LTSETS\_V9\_FV\_C\_VC\_500.MAG

ONS\_BABRD\_500\_PM\_02:LTBAR\_E\_N5\_FV\_C\_VC\_500.MAG

ONS\_BABRD\_500\_PM\_02:LTBAR\_E\_N5\_FA\_P\_I1.MAG

ONS\_CETGD\_500\_PM\_05:LTSETS\_V9\_FA\_P\_I1.MAG

ONS\_CETGD\_500\_PM\_05:LTSETS\_V9\_FA\_B\_IB\_500.MAG

ONS\_BABRD\_500\_PM\_02:LTBAR\_E\_N5\_FV\_B\_VB\_500.MAG

Max

1 20 100

METADADOS [Tamanho: 18 medidas]

ONS\_BABRD\_500\_PM\_02:FREQ [FREQ] [ LT BARREIRAS II / RIODAS EGUAS N5 ] [EQT] [COSR-NE] [1-Confíavel]

ONS\_BABRD\_500\_PM\_02:LTBARDE\_N5\_FA\_A\_IA\_500.MAG [IPHM] [ LT BARREIRAS II / RIODAS EGUAS N5 ] [EQT] [COSR-NE] [1-Confíavel]

ONS\_BABRD\_500\_PM\_02:LTBARDE\_N5\_FA\_B\_IB\_500.MAG [IPHM] [ LT BARREIRAS II / RIODAS EGUAS N5 ] [EQT] [COSR-NE] [1-Confíavel]

ONS\_BABRD\_500\_PM\_02:LTBARDE\_N5\_FA\_C\_IC\_500.MAG [IPHM] [ LT BARREIRAS II / RIODAS EGUAS N5 ] [EQT] [COSR-NE] [1-Confíavel]

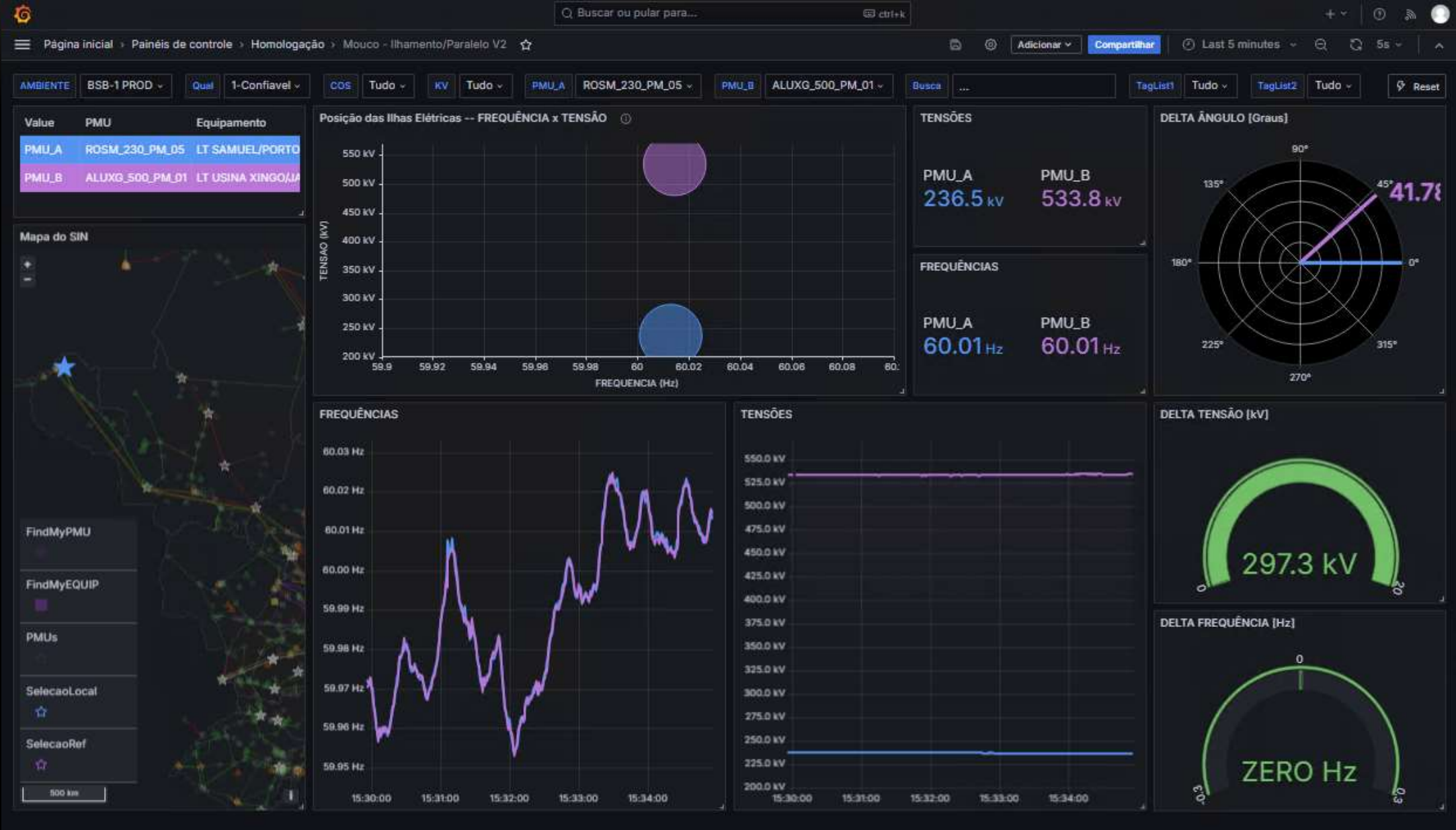
REGISTROS DE EVENTOS @ [RIO-1 PROD]

| Horário             | Tags | Estado   | Descrição  | _ID |
|---------------------|------|----------|--|-----|
| 2024-10-03 17:13:50 |      | Normal   | [BSB-1 PROD] MOSC: OSCILAÇÃO DETECTADA [alertname]=[BSB-1] 1727986 |     |
| 2024-10-03 17:10:10 |      | Alerting | [BSB-1 PROD] MOSC: OSCILAÇÃO DETECTADA [alertname]=[BSB-1] 1727986 |     |
| 2024-10-03 17:10:00 |      | Pending  | [BSB-1 PROD] MOSC: OSCILAÇÃO DETECTADA [alertname]=[BSB-1] 1727986 |     |

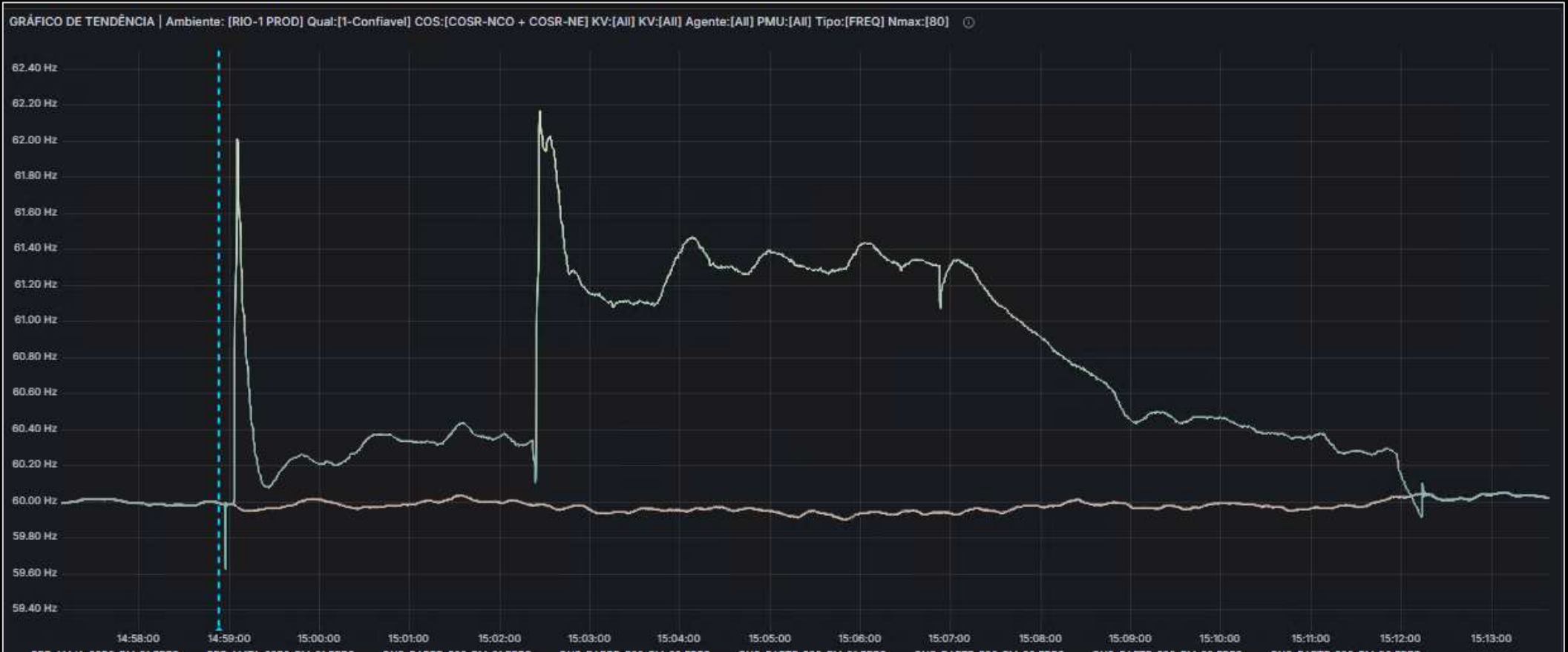
# Live Trend: Frequency Excursions



# Islanding & Resynchronization

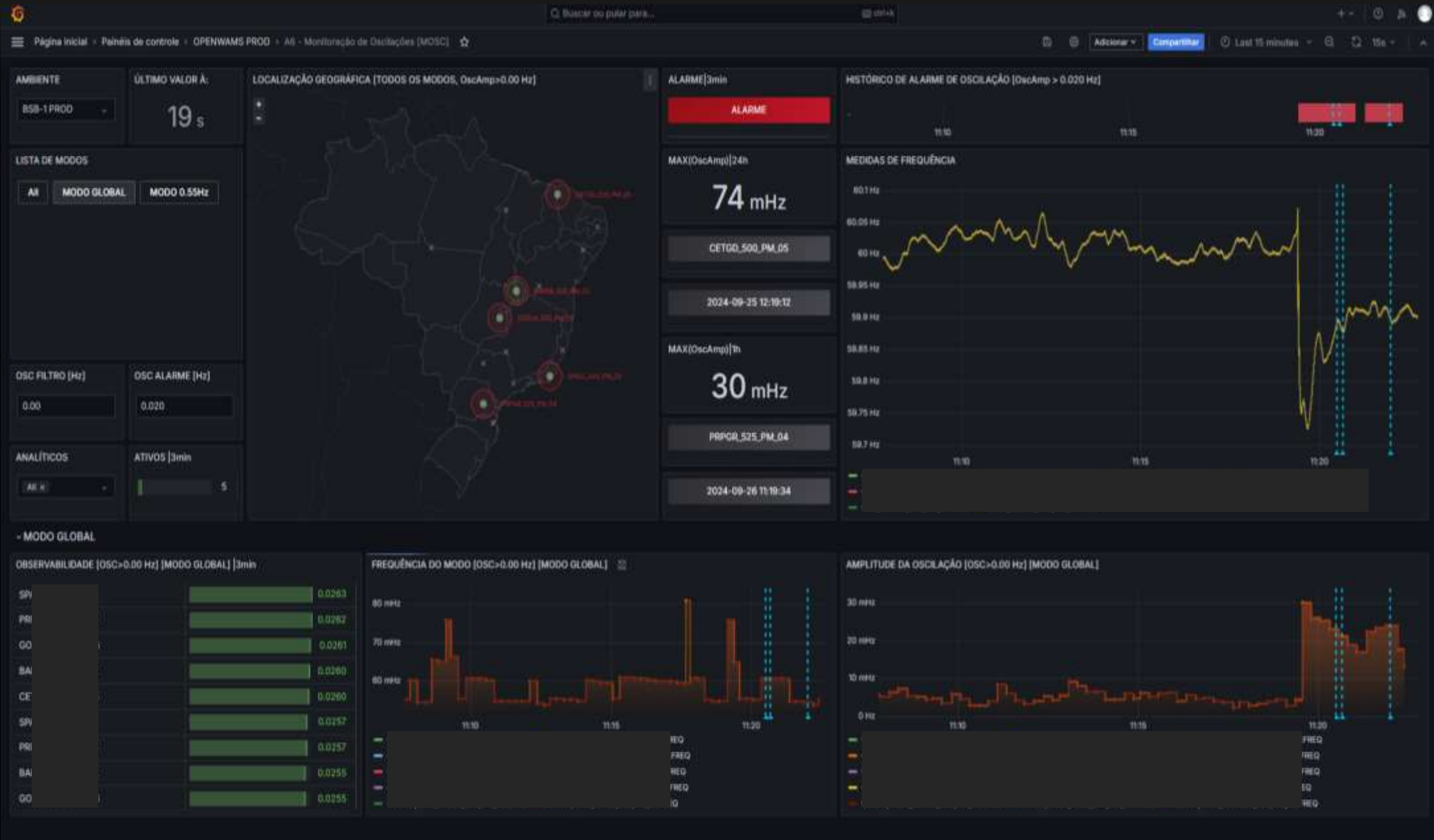


# Islanding Case

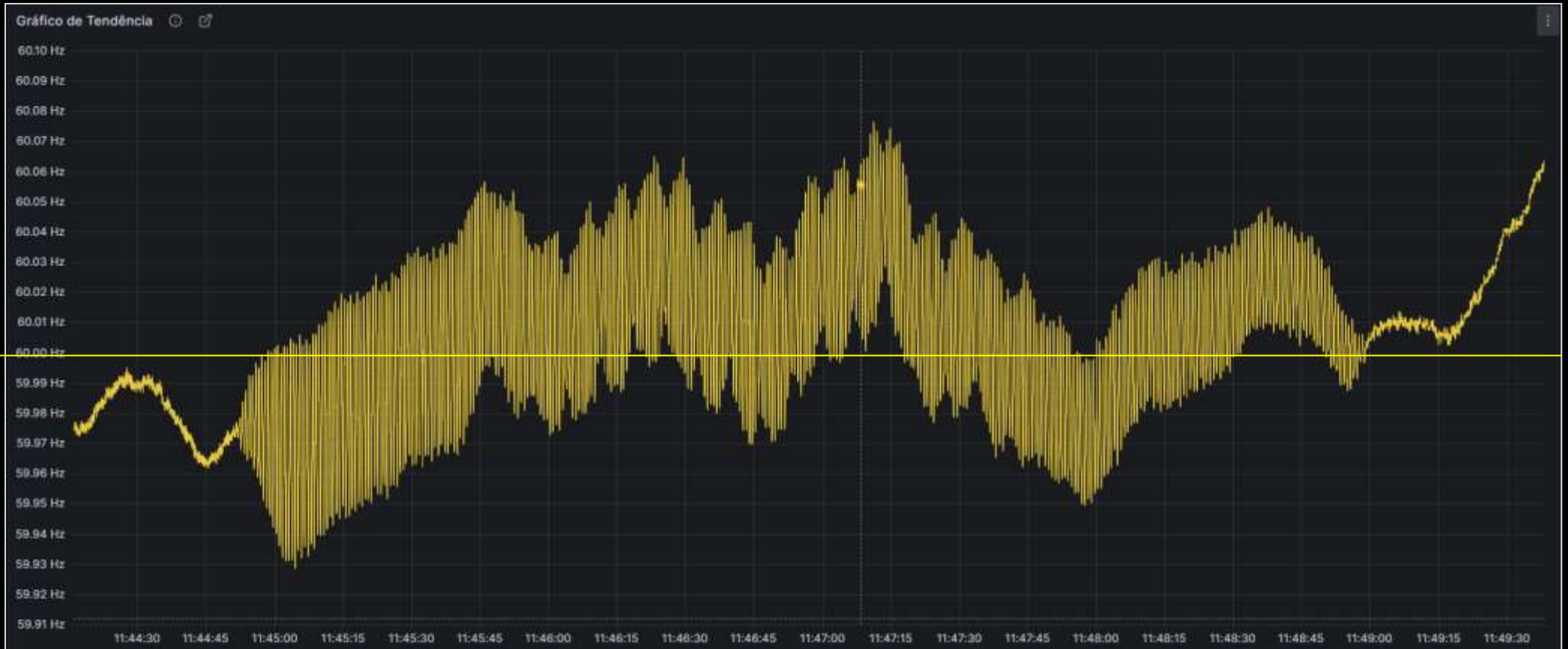




# Oscillatory Monitoring



# Oscillation Case



# Angle Profile and Bottle Necks Monitoring



# Alarm & Events

🔍 Buscar ou pular para... ctrl+k

🏠 Página inicial > ⭐ Favorito > A08 - Anotações e Eventos

Adicionar Compartilhar Last 15 minutes 5s

**AMBIENTE**

RIO-2 DEV

2024-10-08 15:10  
-03:00

**BUSCA**

Enter variable value

**ALERT ID**

All 0 3 5  
6 7 8 9

**STATUS** (8/8 selected)

- All
- Error
- Normal
- Normal (Updated)
- Pending
- Alerting
- Normal (MissingSeries)
- Normal (Paused)

**REGISTROS DE EVENTOS @ [RIO-2 DEV]**

| Horário                             | alert_id | Tags | Estado             | Descrição   | _t0           | _t1          |
|-------------------------------------|----------|------|--------------------|---|---------------|--------------|
| <a href="#">2024-10-04 17:47:00</a> | 3        | -    | Normal             | [BSB-1 PROD] MOSC: OSCILAÇÃO DETECTADA (alertname=[BSB-1 PROD] MOSC: OSCILAÇÃO DETECTADA, grafana_folder=OPENWA074720000      | 1728074920000 |              |
| <a href="#">2024-10-04 17:43:30</a> | 3        | -    | Alerting           | [BSB-1 PROD] MOSC: OSCILAÇÃO DETECTADA (alertname=[BSB-1 PROD] MOSC: OSCILAÇÃO DETECTADA, grafana_folder=OPENWA074510000      | 1728074710000 |              |
| <a href="#">2024-10-04 17:43:20</a> | 3        | -    | Pending            | [BSB-1 PROD] MOSC: OSCILAÇÃO DETECTADA (alertname=[BSB-1 PROD] MOSC: OSCILAÇÃO DETECTADA, grafana_folder=OPENWA074500000      | 1728074700000 |              |
| <a href="#">2024-10-04 17:27:20</a> | 3        | -    | Normal             | [BSB-1 PROD] MOSC: OSCILAÇÃO DETECTADA (alertname=[BSB-1 PROD] MOSC: OSCILAÇÃO DETECTADA, grafana_folder=OPENWA073540000      | 1728073740000 |              |
| <a href="#">2024-10-04 17:26:50</a> | 3        | -    | Alerting           | [BSB-1 PROD] MOSC: OSCILAÇÃO DETECTADA (alertname=[BSB-1 PROD] MOSC: OSCILAÇÃO DETECTADA, grafana_folder=OPENWA073510000      | 1728073710000 |              |
| <a href="#">2024-10-04 17:26:40</a> | 3        | -    | Pending            | [BSB-1 PROD] MOSC: OSCILAÇÃO DETECTADA (alertname=[BSB-1 PROD] MOSC: OSCILAÇÃO DETECTADA, grafana_folder=OPENWA073500000      | 1728073700000 |              |
| <a href="#">2024-10-04 14:30:46</a> | 6        | -    | Normal (Paused)    | [BSB-1 PROD] MOSC: DISPONIBILIDADE DO SERVIÇO (alertname=[BSB-1 PROD] MOSC: DISPONIBILIDADE DO SERVIÇO, grafana_fold062946000 | 1728063146000 |              |
| <a href="#">2024-10-04 13:08:40</a> | 6        | -    | Normal             | [BSB-1 PROD] MOSC: DISPONIBILIDADE DO SERVIÇO (alertname=[BSB-1 PROD] MOSC: DISPONIBILIDADE DO SERVIÇO, grafana_fold058020000 | 728058220000  |              |
| <a href="#">2024-10-04 12:23:50</a> | 6        | -    | Alerting           | [BSB-1 PROD] MOSC: DISPONIBILIDADE DO SERVIÇO (alertname=[BSB-1 PROD] MOSC: DISPONIBILIDADE DO SERVIÇO, grafana_fold055330000 | 728055330000  |              |
| <a href="#">2024-10-04 12:23:40</a> | 6        | -    | Pending            | [BSB-1 PROD] MOSC: DISPONIBILIDADE DO SERVIÇO (alertname=[BSB-1 PROD] MOSC: DISPONIBILIDADE DO SERVIÇO, grafana_fold055320000 | 728055320000  |              |
| <a href="#">2024-10-03 17:13:50</a> | 3        | -    | Normal             | [BSB-1 PROD] MOSC: OSCILAÇÃO DETECTADA (alertname=[BSB-1 PROD] MOSC: OSCILAÇÃO DETECTADA, grafana_folder=OPENWA986330000      | 727986330000  |              |
| <a href="#">2024-10-03 17:10:10</a> | 3        | -    | Alerting           | [BSB-1 PROD] MOSC: OSCILAÇÃO DETECTADA (alertname=[BSB-1 PROD] MOSC: OSCILAÇÃO DETECTADA, grafana_folder=OPENWA986110000      | 1727986310000 |              |
| <a href="#">2024-10-03 17:10:00</a> | 3        | -    | Pending            | [BSB-1 PROD] MOSC: OSCILAÇÃO DETECTADA (alertname=[BSB-1 PROD] MOSC: OSCILAÇÃO DETECTADA, grafana_folder=OPENWA986100000      | 727986300000  |              |
| <a href="#">2024-10-03 17:08:42</a> | 0        | ons  | -                  | CETGD_500_PM_05: caso de frequencia   | 986022000     | 727986222000 |
| <a href="#">2024-10-03 13:27:10</a> | 3        | -    | Normal             | [BSB-1 PROD] MOSC: OSCILAÇÃO DETECTADA (alertname=[BSB-1 PROD] MOSC: OSCILAÇÃO DETECTADA, grafana_folder=OPENWA972730000      | 1727972930000 |              |
| <a href="#">2024-10-03 13:26:20</a> | 3        | -    | Alerting           | [BSB-1 PROD] MOSC: OSCILAÇÃO DETECTADA (alertname=[BSB-1 PROD] MOSC: OSCILAÇÃO DETECTADA, grafana_folder=OPENWA972680000      | 1727972880000 |              |
| <a href="#">2024-10-03 13:26:10</a> | 3        | -    | Pending            | [BSB-1 PROD] MOSC: OSCILAÇÃO DETECTADA (alertname=[BSB-1 PROD] MOSC: OSCILAÇÃO DETECTADA, grafana_folder=OPENWA972670000      | 1727972870000 |              |
| <a href="#">2024-10-03 03:49:00</a> | 3        | -    | Normal             | [BSB-1 PROD] MOSC: OSCILAÇÃO DETECTADA (alertname=[BSB-1 PROD] MOSC: OSCILAÇÃO DETECTADA, grafana_folder=OPENWA9338040000     | 727938240000  |              |
| <a href="#">2024-10-03 03:48:20</a> | 3        | -    | Alerting           | [BSB-1 PROD] MOSC: OSCILAÇÃO DETECTADA (alertname=[BSB-1 PROD] MOSC: OSCILAÇÃO DETECTADA, grafana_folder=OPENWA9338000000     | 727938200000  |              |
| <a href="#">2024-10-03 03:48:10</a> | 3        | -    | Pending            | [BSB-1 PROD] MOSC: OSCILAÇÃO DETECTADA (alertname=[BSB-1 PROD] MOSC: OSCILAÇÃO DETECTADA, grafana_folder=OPENWA9337990000     | 1727938190000 |              |
| <a href="#">2024-10-02 16:09:10</a> | 3        | -    | Normal (MissingSer | [BSB-1 PROD] MOSC: OSCILAÇÃO DETECTADA (alertname=[BSB-1 PROD] MOSC: OSCILAÇÃO DETECTADA, datasource_uid=fdv04er896050000     | 727896250000  |              |

1 - 21 of 176 rows

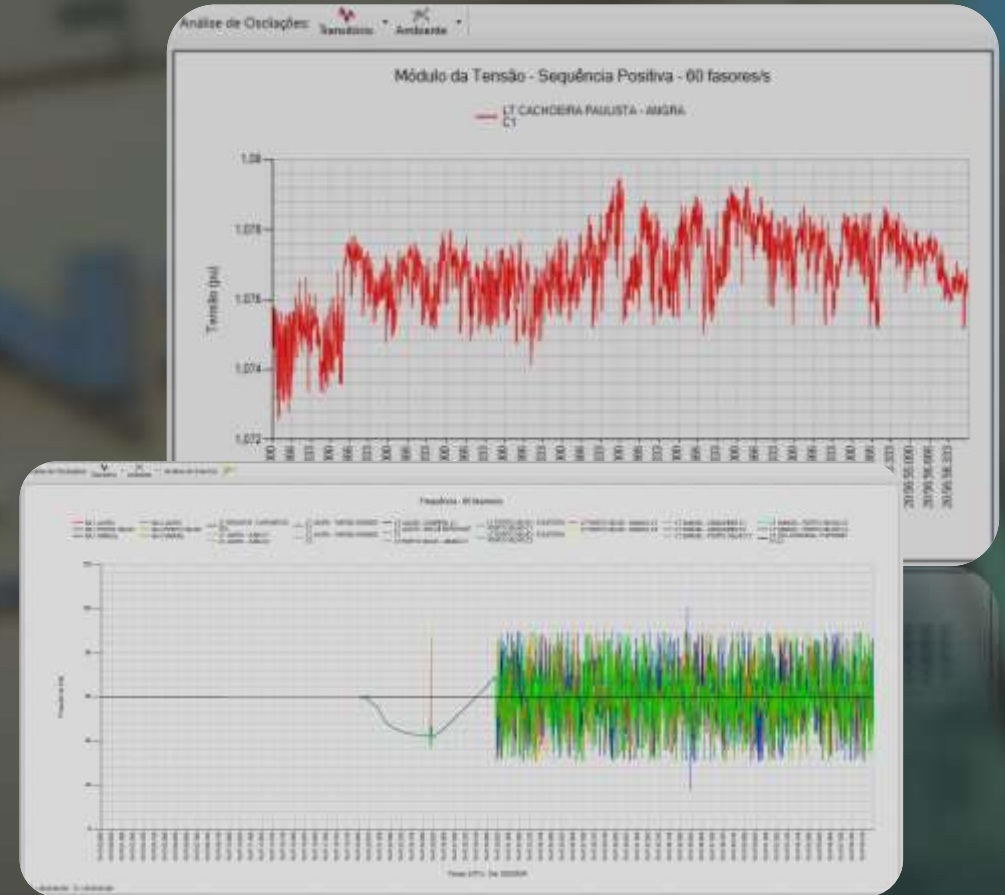
# Standalone Offline Analysis

## MedPlot Software

- Partnership with Universidade Federal de Santa Catarina (UFSC)
- Software developed for offline analysis of synchrophasors
- Integration with openHistorian database

## Features

- Historian Trending
- Prony Analysis
- DFT Analysis
- CVA Analysis
- Detecion, identification, and geolocation of disturbances



# PMU Data Quality

529

1 min

**NÚMERO DE PMUS POR CLASSES DE ...**

|                |     |
|----------------|-----|
| 1-Confíavel    | 312 |
| 2-Suspeita     | 3   |
| 3-Ruim         | 176 |
| 4-Indisponível | 38  |

**NÚMERO DE PMUS POR AGENTE**

**ACUMULADO DA MÉDIA DOS ÍNDICES DE QUALIDADE POR AGENTE AO LONGO DO PERÍODO SELECIONADO**

**HISTÓRICO DE DESEMPENHO GERAL DE QUALIDADE**

**PONTUAÇÃO GERAL**

# 60%

**HISTÓRICO DE DESEMPENHO POR AGENTE**

DESEMPENHO DE QUALIDADE PARA [?]

DESEMPENHO DE QUALIDADE PARA [?]

DESEMPENHO DE QUALIDADE PARA [?]

DESEMPENHO DE QUALIDADE PARA [?]

**AGENTE**

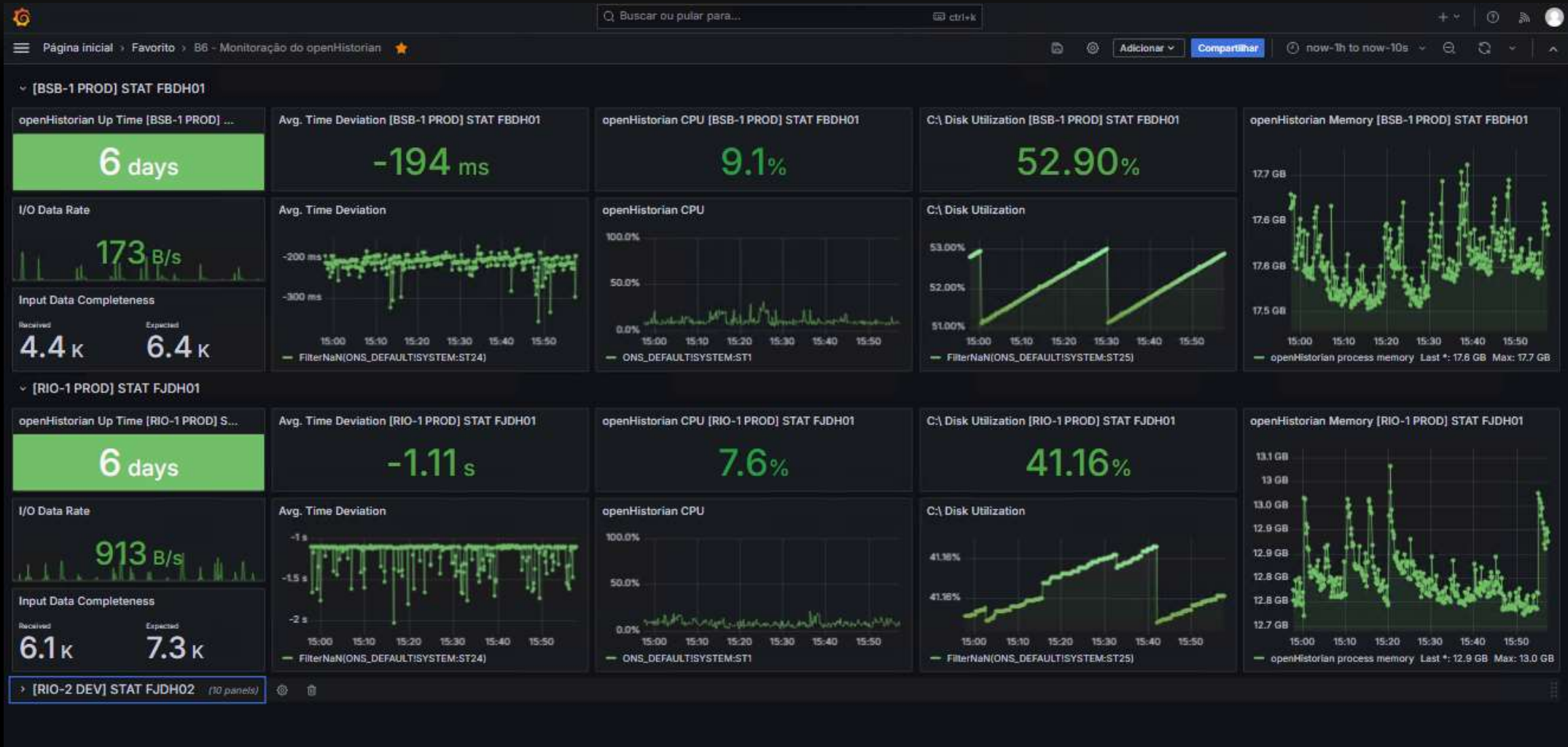
All

**LISTA DE PMUS**

| Agente | PMU  | Status         |
|--------|------|----------------|
| LE:    | M_01 | 3-Ruim         |
| BR     | M_01 | 1-Confíavel    |
| EV     | M_01 | 4-Indisponível |
| EV     | M_02 | 4-Indisponível |
| EV     | M_03 | 4-Indisponível |
| EV     | M_04 | 4-Indisponível |
| BR     | M_01 | 1-Confíavel    |
| ET     | M_04 | 3-Ruim         |
| JEI    | M_05 | 1-Confíavel    |
| EQ     | M_01 | 1-Confíavel    |
| EQ     | M_02 | 1-Confíavel    |
| NE     | M_03 | 1-Confíavel    |
| EQ     | M_01 | 1-Confíavel    |
| EQ     | M_02 | 1-Confíavel    |
| EQ     | M_03 | 1-Confíavel    |
| EQ     | M_06 | 1-Confíavel    |
| ST     | M_07 | 4-Indisponível |
| RU     | M_01 | 1-Confíavel    |

Count 529

# openHistorian Monitoring



# Our perception so far...

*One Year Partnership!*

**Great partnership between ONS and GPA on technical support and problem solving.**

**Project's Mission:** from temporary to permanent system

Good feedback about the easy assessibility and tools navigation due to Grafana intuitive dashboards design and web-based.

Increase in the data use confidence due to data quality real-time ranking applications

Open-platform enabling easy access to the real-time data for custom application developments.

User-interface highly customizable



# We have a long way to go!

## In Progress:

- PMU in CIM/xml model
- Offline analysis application

## Prioritized:

- Integration with SCADA
- Module of oscillation modes
- Disturbance detection module

## Backlog:

- ICCP integration for SCADA
- PMU in CIM/xml model
- Module of oscillation modes
- Inertia module
- Islanding module
- Module of linear state estimation
- Disturbance detection module
- Offline analysis application
- Integration with Kafka bus

**Obrigado!**

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