Asset Performance Management

A SUCCESSFUL JOURNEY OF AVEVA™ PI SYSTEM™ AND AVEVA™ PREDICTIVE ANALYTICS ON MAINTENANCE IN BRAZIL

Presented by: Pedro Costa, Sandy Lopes & Rafael Cruz

Pedro Henrique Moura Costa

Sr. System Specialist

Norsk Hydro Brazil
Pedro.costa@hydro.com

Sandy Caroline Azevedo Lopes

Reliability Engineer

Norsk Hydro Brazil
Sandy.lopes@hydro.com

Rafael Cruz

Project Manager

Radix Engineering & Software
Rafael.Cruz@radixeng.com

Norsk Hydro

Norsk Hydro

Founded in 1905, Hydro has more than 118 years of history with around 32 thousand employees currently present in 40 countries.

Our purpose is to create a more viable society by developing natural resources into products and solutions in an innovative and efficient way.

We are across the entire aluminum value chain**, from energy to bauxite mining and alumina refining, primary aluminum, aluminum extrusions and aluminum recycling.**

OUR VALUES

Care

We act with respect for people and the environment and place safety at the heart of our operations.

Courage

We break new ground and take measured risks with agility, accountability and foresight.

Collaboration

We work as a partner internally and externally to unit competencies and create win-win opportunities.

Hydro Way

Norsk Hydro

> “We want to be at the forefront of industries that care about a **more sustainable future**.”

Hilde Merethe Aasheim, CEO

Norsk Hydro

Global Sustainability Goals

In 2022 we produced our first near-zero volume aluminum

Climate Ambitions

Little or almost zero material by **2025 and 2030**

30% emission reduction until **2030**

Zero emission until **2050**

Environmental Ambitions

1:1 Rehabilitation of available mining areas within two hydrological stations after the start of operations.

No net loss of **biodiversity** in **new projects**

50% reduction in the use of materials that emit greenhouse gases by **2030** (compared to **2018**)

Norsk Hydro Brazil

Bauxite

Hydro Paragominas (100%)

11 millions tons per year

244 km pipeline extension

11 millions

production

tons per year

Alumina

Hydro Alunorzte (62%)

6,3 million ton

Biggest Alumina Refinery outside of China

6,2 million

alumina Production

tons per year

Aluminum Metal

Albras (51%)

Capacity:
460 thousand tons (100%)

Biggest producer of

aluminum metal in Brazil

405

thousand tons primary metal production

Hydro Energy

Volumes Sold

300 MW

Hydro Extrusion

Three extrusion plants

84 thousand tons per year

Strong position in the Brazilian extrusion market

30.17’ tt

Sales amount extrusion for external market

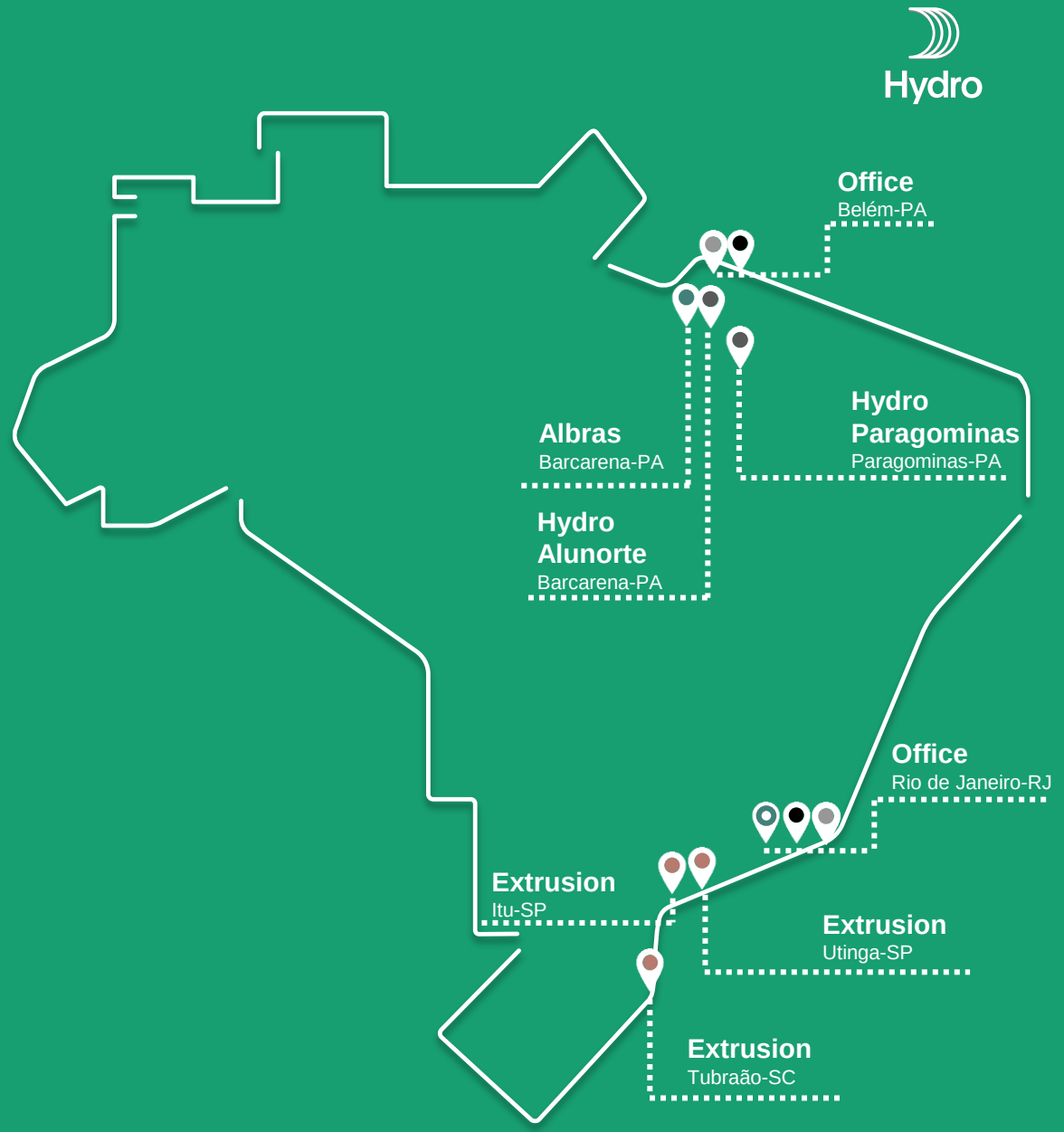
TWh: Terawatt-hour **Mt:** megaton **Mtpy:** megaton per year **Tpy:** ton per year **Km:** kilometer

Norsk Hydro Brazil

Technology, people, and Sustainability

The majority of our assets, operations, and employees **are located in the state of Pará, in northern Brazil,** specifically in the Amazon region – from bauxite extraction to alumina refining and primary metal production. That's why **we establish strict environmental control and monitoring standards, in addition to a structured and comprehensive process of engagement with neighboring communities.**

- Hydro Bauxite & Alumina plants – Bauxite mining and Alumina Refinery
- Albras – Aluminium Metal process
- Hydro Extrusion plants and office – Final product to the market
- Hydro Energy
- Hydro REIN
- Administrative and Commercial Offices



Asset Performance Management

MINING & METALS | BRAZIL

Norsk Hydro Brazil achieved a saving over than $4.7M on maintenance cost

Challenge

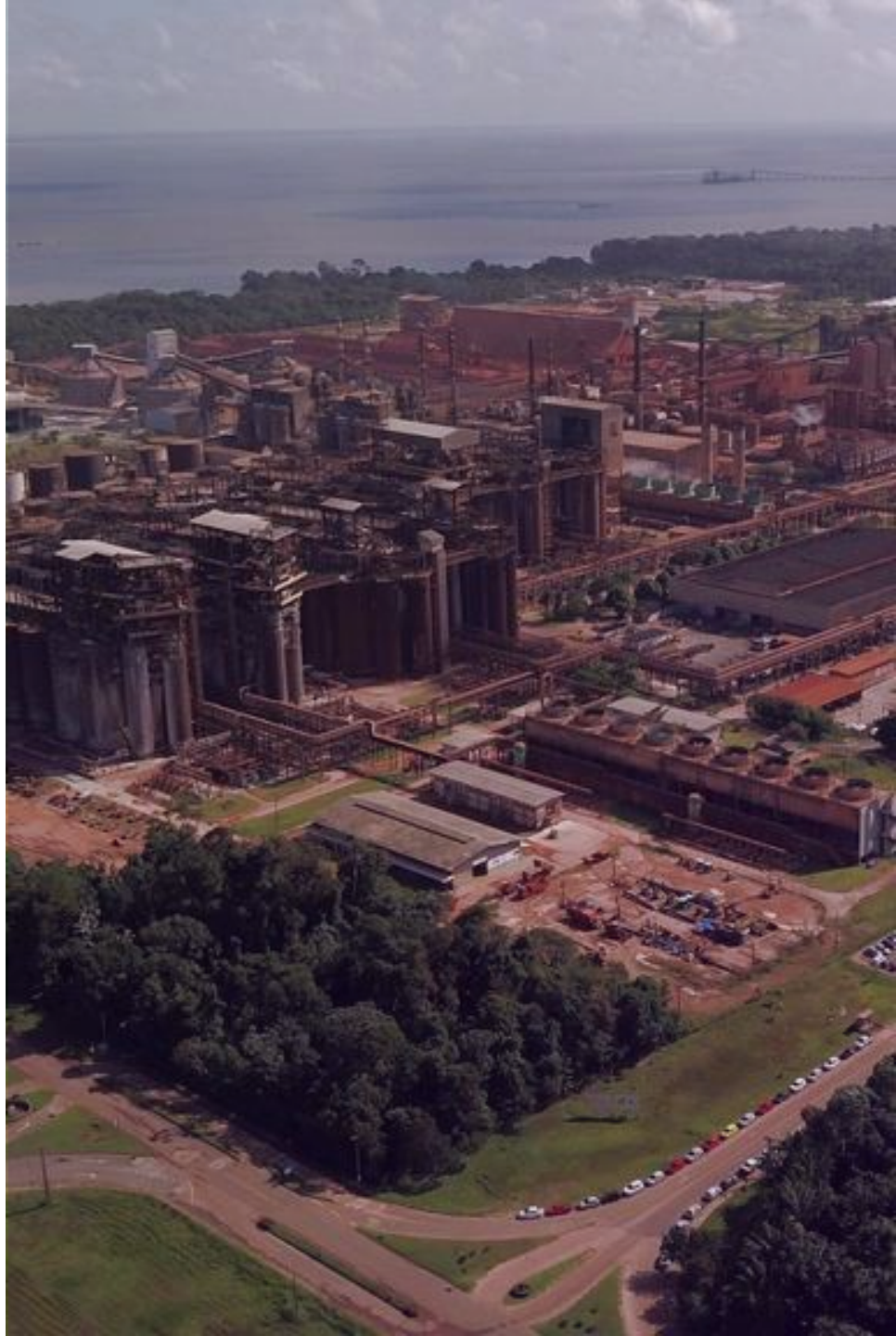
- **High maintenance costs**
- **Premature asset scrappage**
- **Production losses due to asset failures**
- **A lack of readily available information and historical data**

Solution

Implemented the first Hydro's Asset Monitoring Center consolidating **AVEVA™ PI System™** to streamline data collection, access, analysis, and reporting on maintenance perspective and deployed **AVEVA™ Predictive Analytics** for some critical assets

Results

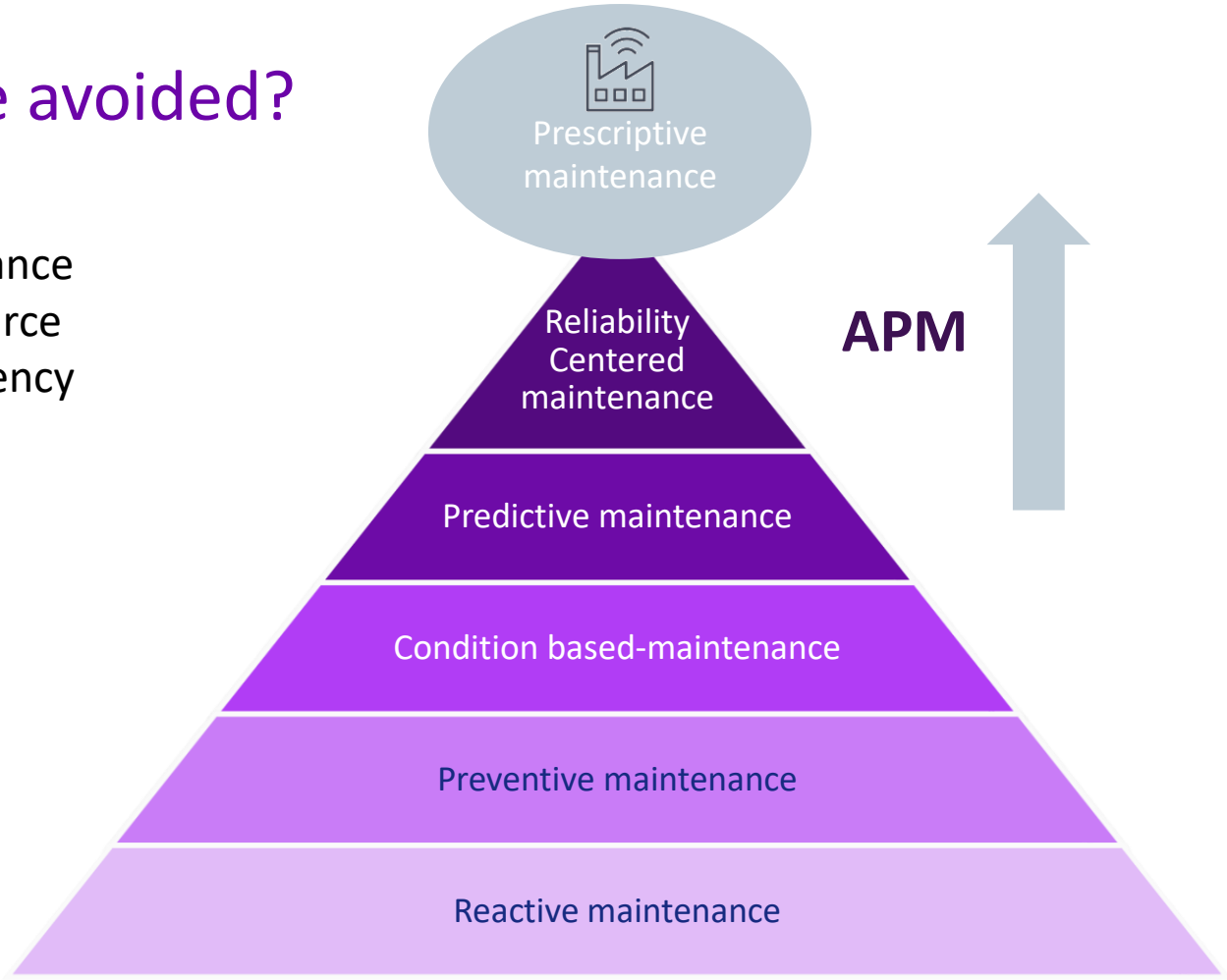
- **Achieved significant cost savings**
- **Costs avoided through asset failure anticipation based on notifications and operational routines**
- **Reduced human exposure to unplanned maintenance tasks**
- **Increased operational efficiency and safety**



Challenge

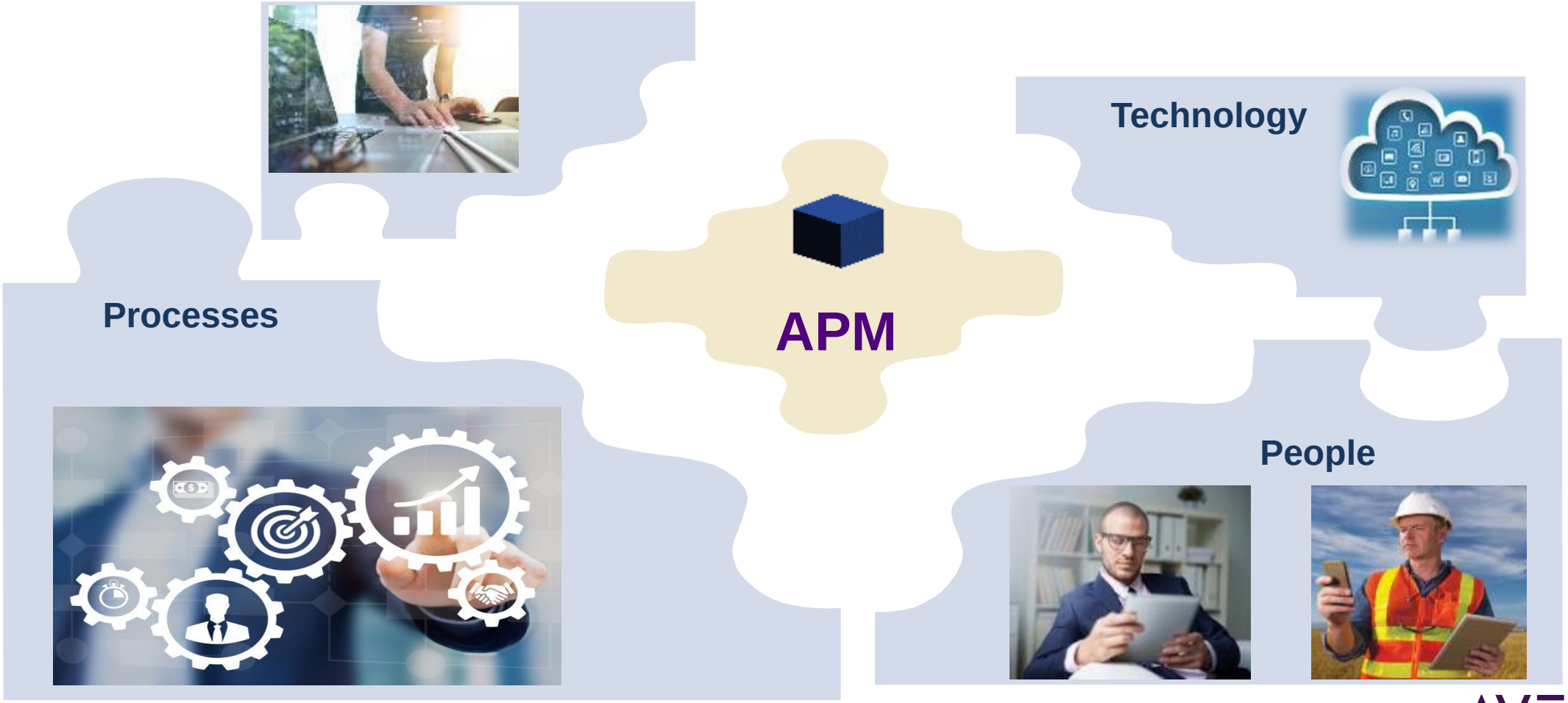
What if premature failures could be avoided?

- Reactive maintenance
- High human resource working in emergency
- High risks
- High cost



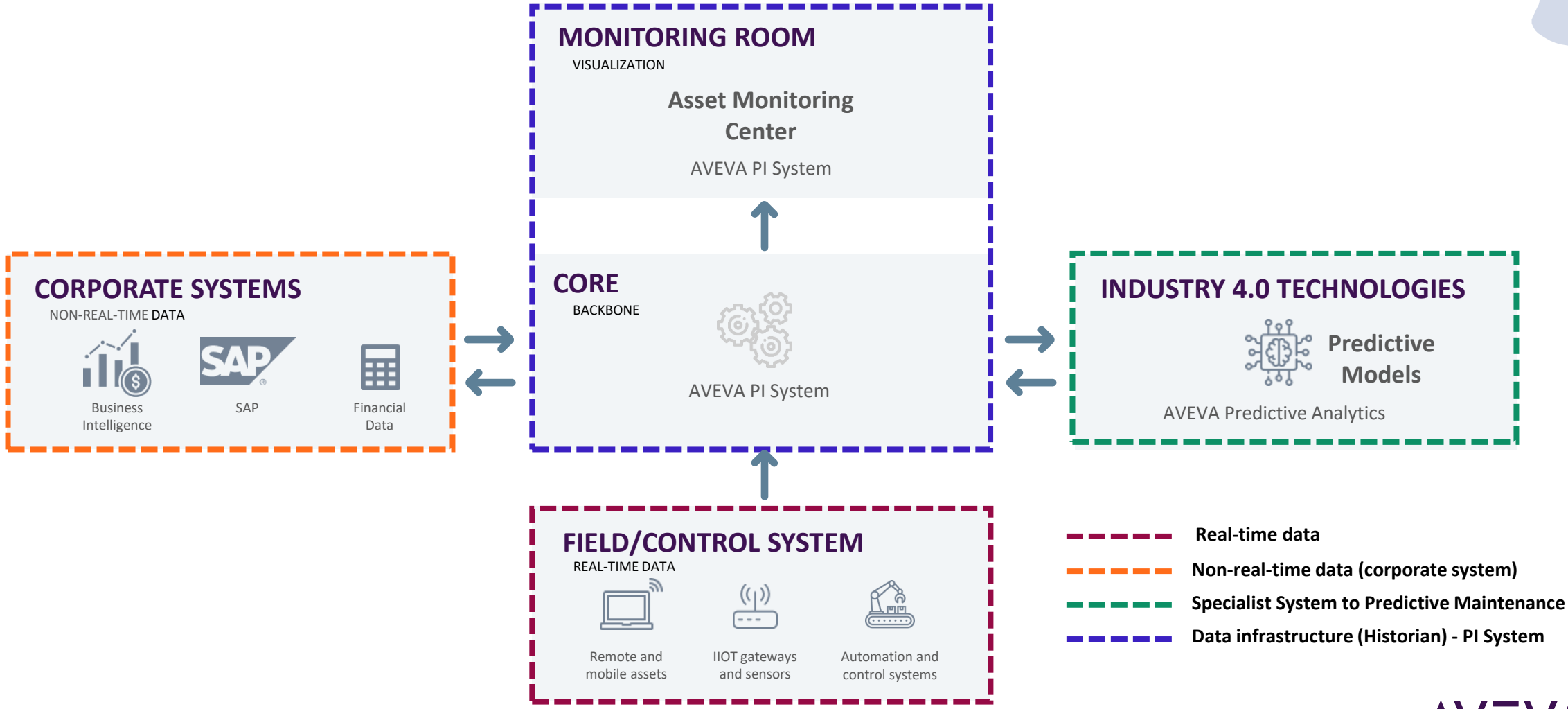
How the APM works in Norsk Hydro Brazil

The entire approach focused on the Digital Transformation pillars



Centralizing system built with AVEVA tools

Solution architecture



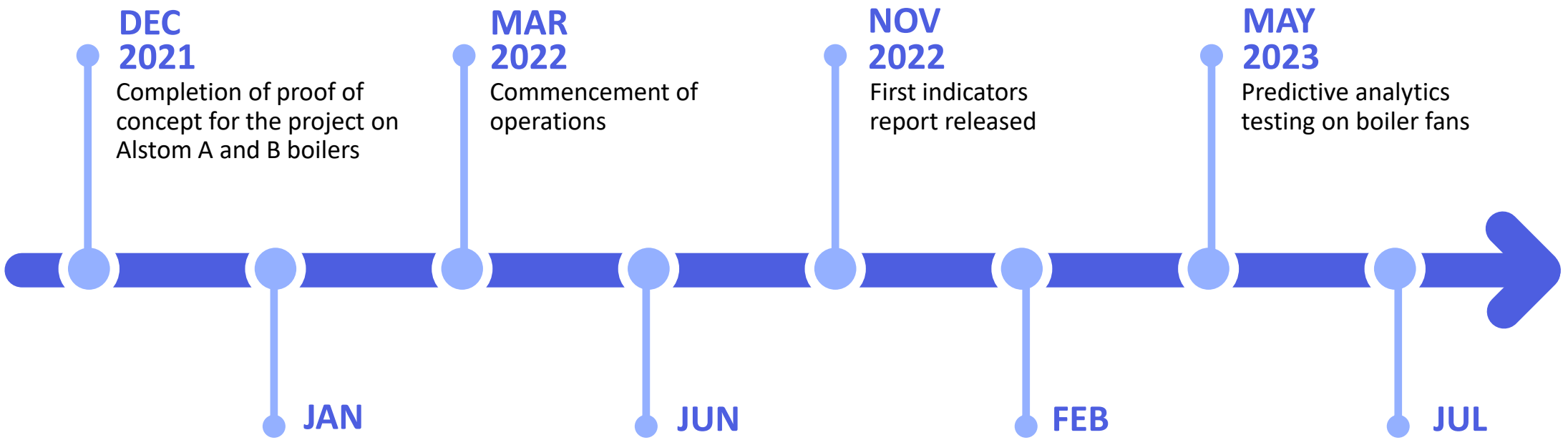
APM Monitoring Center

- Development center
- Monitoring of new alerts and deviations
  - Asset Analytics and Predictive Analytics
- Sending reports with KPI’s
- Direct communication with control room operators
- Forecast to determine maintenance window
- Guidance for industrial maintenance

Processes

People

Timeline



APM Numbers

4,000+
Assets monitored

57,659
Field TAG's

16,981
Analyses

+$4.7M
Cost avoided

50+
Success cases
notified in one year

9,086
Notifications

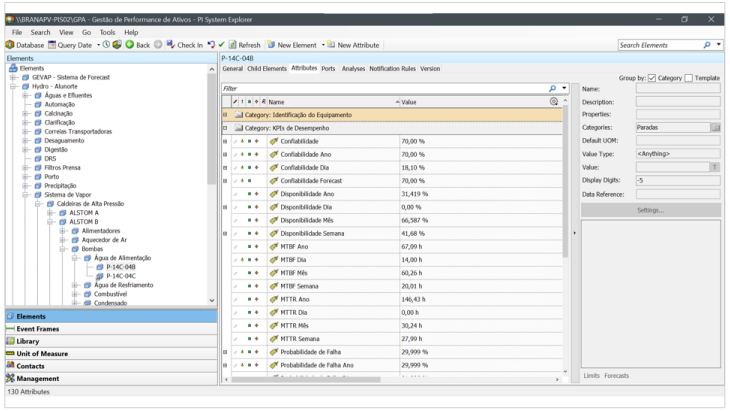
AVEVA

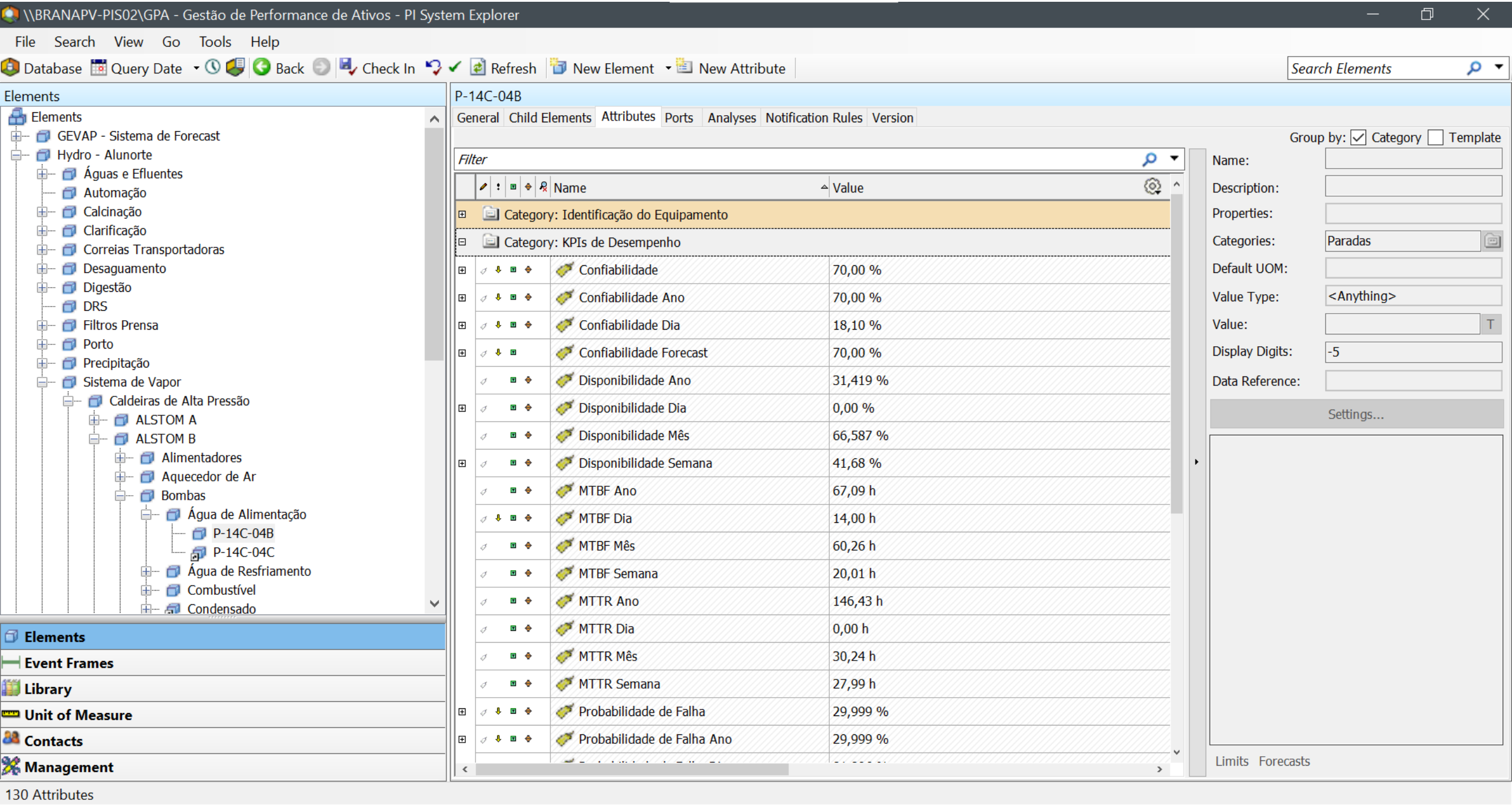
Resources

Tools and resources used from AVEVA products

AVEVA PI Data Archive as the centralized industrial data storage infrastructure of the Asset Performance Management;

AVEVA PI Server asset framework hierarchy to enhance the data context from assets;



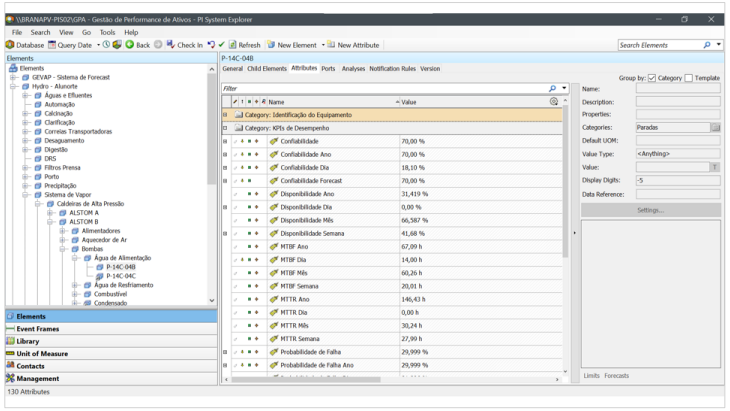

\\BRANAPV-PIS02\GPA - Gestão de Performance de Ativos - PI System Explorer
File Search View Go Tools Help
Database Query Date Back Check In Refresh New Element New Attribute
Search Elements
Elements
Elements
GEVAP - Sistema de Forecast
Hydro - Alunorte
Águas e Efluentes
Automação
Calcinação
Clarificação
Correias Transportadoras
Desaguamento
Digestão
DRS
Filtros Prensa
Porto
Precipitação
Sistema de Vapor
Caldeiras de Alta Pressão
ALSTOM A
ALSTOM B
Alimentadores
Aquecedor de Ar
Bombas
Água de Alimentação
P-14C-04B
P-14C-04C
Água de Resfriamento
Combustível
Condensado
Elements
Event Frames
Library
Unit of Measure
Contacts
Management
P-14C-04B
General Child Elements Attributes Ports Analyses Notification Rules Version
Group by: Category Template
Filter
Name Value
Category: Identificação do Equipamento
Category: KPIs de Desempenho
Confiabilidade 70,00 %
Confiabilidade Ano 70,00 %
Confiabilidade Dia 18,10 %
Confiabilidade Forecast 70,00 %
Disponibilidade Ano 31,419 %
Disponibilidade Dia 0,00 %
Disponibilidade Mês 66,587 %
Disponibilidade Semana 41,68 %
MTBF Ano 67,09 h
MTBF Dia 14,00 h
MTBF Mês 60,26 h
MTBF Semana 20,01 h
MTTR Ano 146,43 h
MTTR Dia 0,00 h
MTTR Mês 30,24 h
MTTR Semana 27,99 h
Probabilidade de Falha 29,999 %
Probabilidade de Falha Ano 29,999 %
Name:
Description:
Properties:
Categories: Paradas
Default UOM:
Value Type: <Anything>
Value:
Display Digits: -5
Data Reference:
Settings...
Limits Forecasts
130 Attributes

Resources

Tools and resources used from AVEVA products

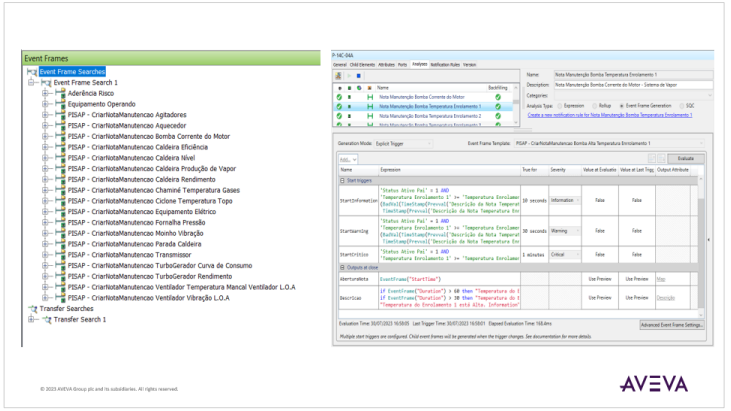
AVEVA PI Data Archive as the centralized industrial data storage infrastructure of the Asset Performance Management;

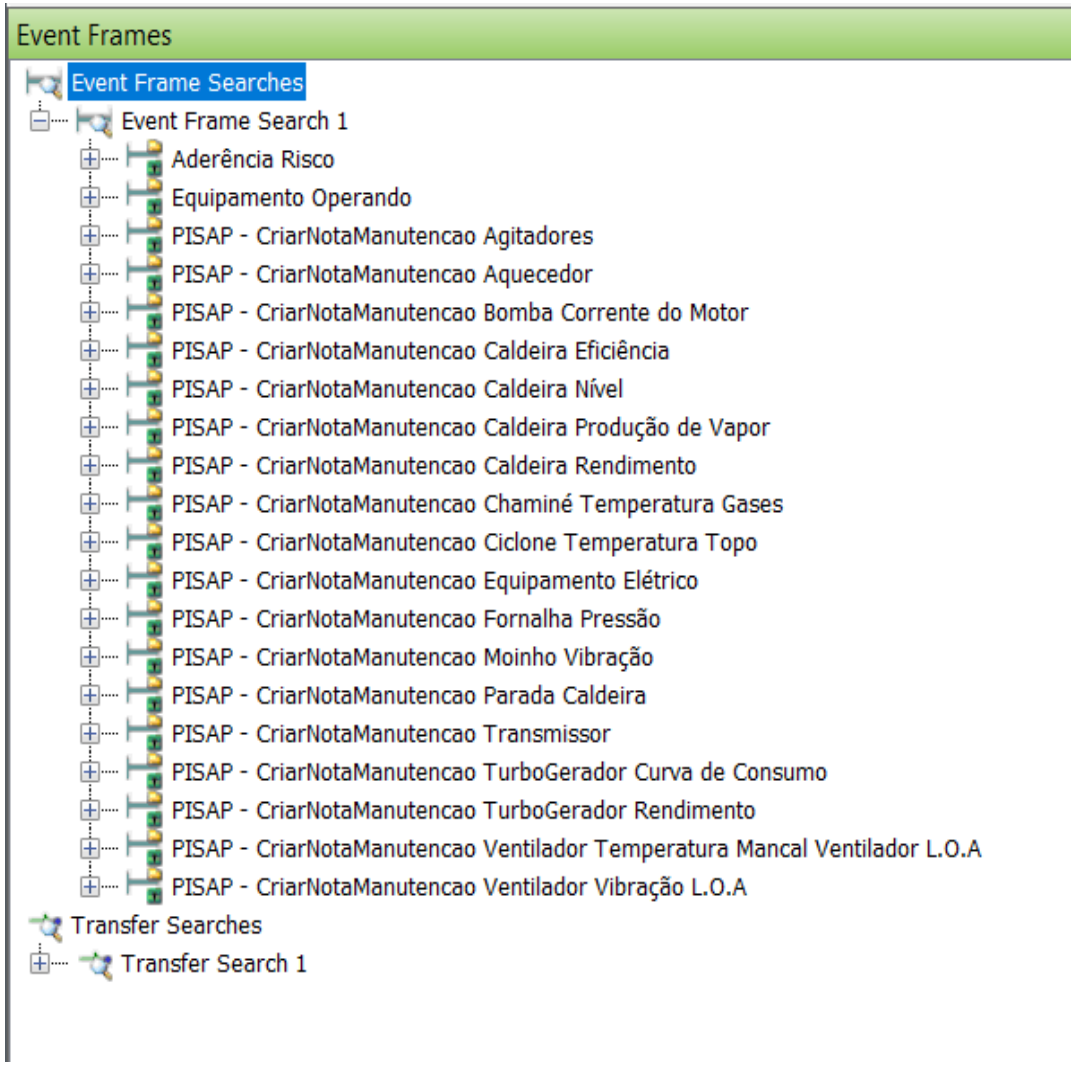
AVEVA PI Server asset framework hierarchy to enhance the data context from assets;

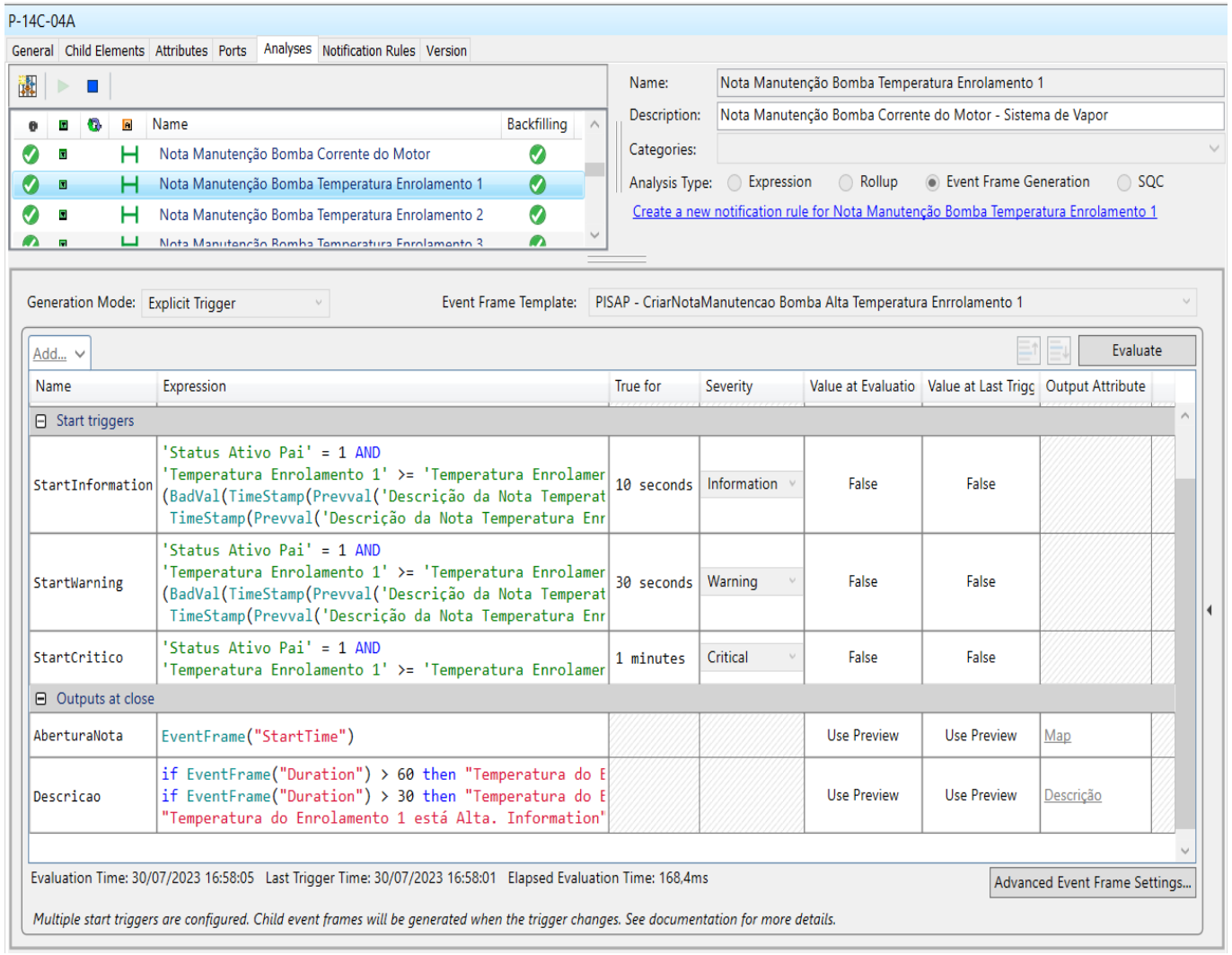


PI Analysis as the engine to calculate:

- The reliability indicators from assets (uptime, downtime, MTBF, MTTR, others);
- The alerts generation to apply the CBM concept;
- The SQC on key variables.





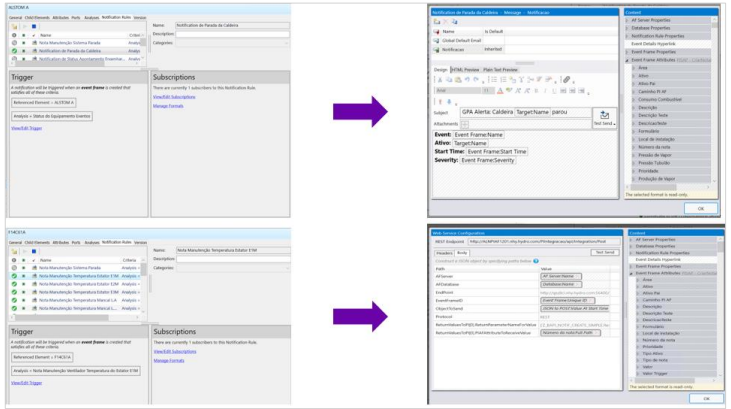


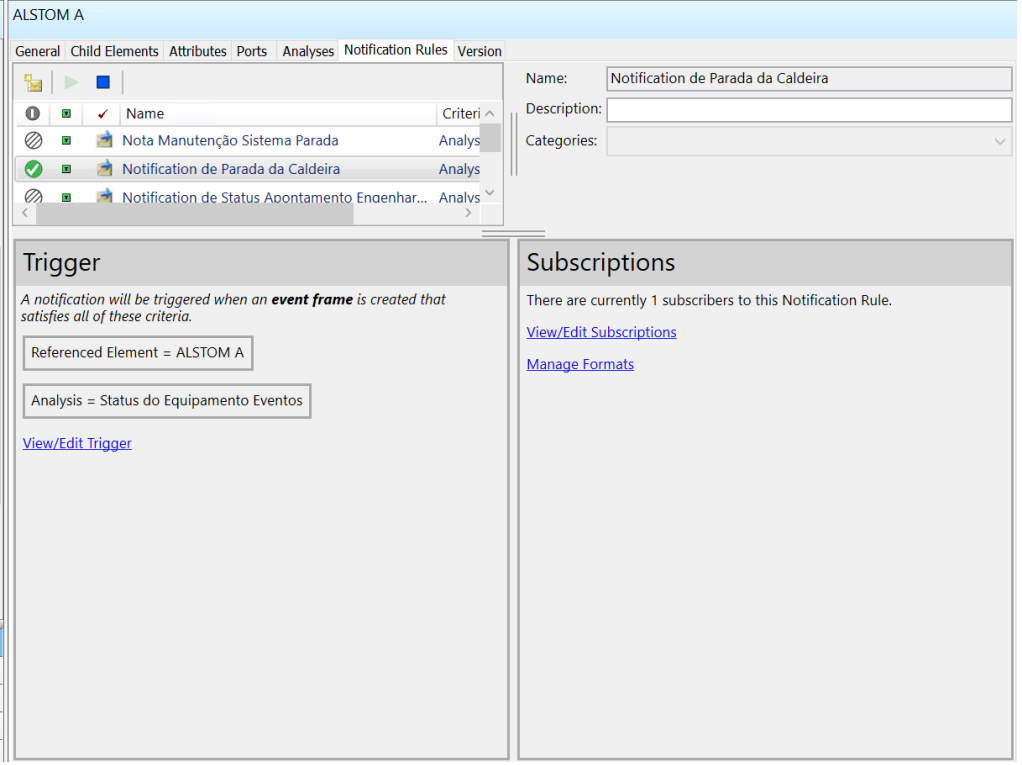
Resources

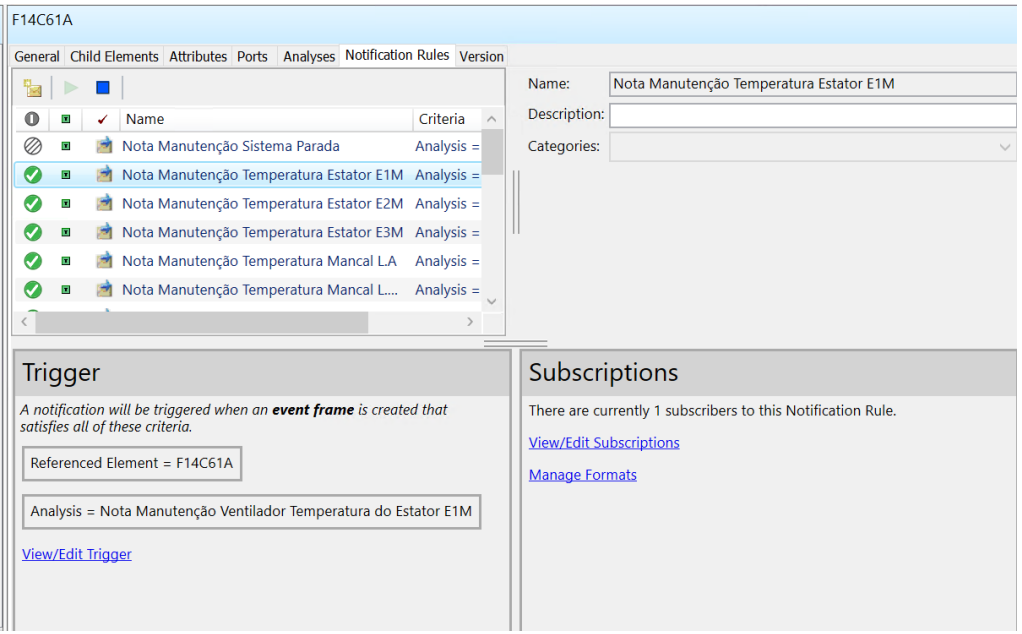
Tools and resources used from AVEVA products

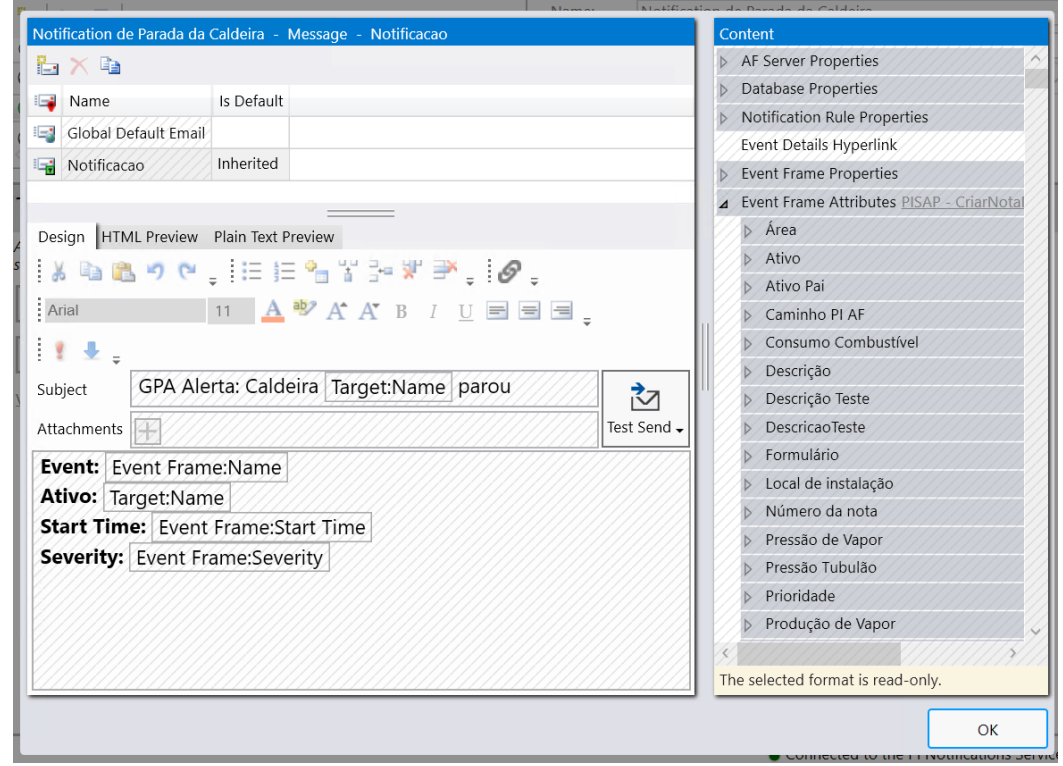
AVEVA PI Notifications as the messaging solution to

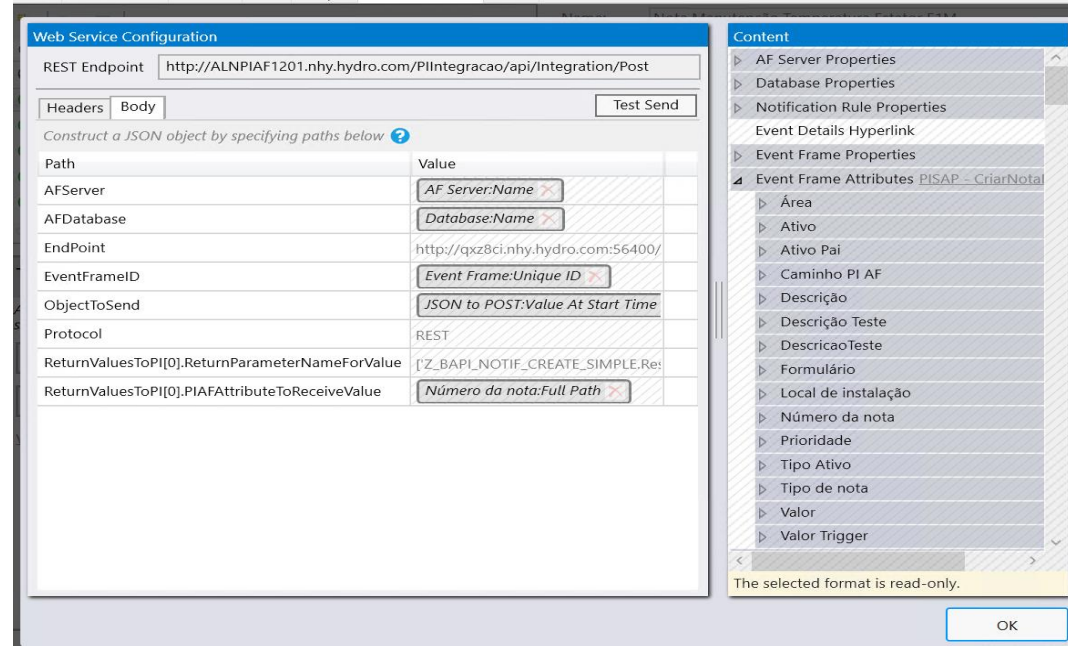
- Send email according to the rules of CBM created or prediction results from SQC Analytics;
- Open maintenance notifications on the ERP of Hydro automatically;
- Send periodic reports to the managers with reliability indicators and asset status;




ALSTOM A
General
Child Elements
Attributes
Ports
Analyses
Notification Rules
Version
Name
Criteri
Nota Manutenção Sistema Parada
Analys
Notification de Parada da Caldeira
Analys
Notification de Status Apontamento Engenhar...
Analys
Name:
Notification de Parada da Caldeira
Description:
Categories:
Trigger
A notification will be triggered when an event frame is created that satisfies all of these criteria.
Referenced Element = ALSTOM A
Analysis = Status do Equipamento Eventos
View/Edit Trigger
Subscriptions
There are currently 1 subscribers to this Notification Rule.
View/Edit Subscriptions
Manage Formats


F14C61A
General
Child Elements
Attributes
Ports
Analyses
Notification Rules
Version
Name
Criteria
Nota Manutenção Sistema Parada
Analysis =
Nota Manutenção Temperatura Estator E1M
Analysis =
Nota Manutenção Temperatura Estator E2M
Analysis =
Nota Manutenção Temperatura Estator E3M
Analysis =
Nota Manutenção Temperatura Mancal L.A
Analysis =
Nota Manutenção Temperatura Mancal L....
Analysis =
Name:
Nota Manutenção Temperatura Estator E1M
Description:
Categories:
Trigger
A notification will be triggered when an event frame is created that satisfies all of these criteria.
Referenced Element = F14C61A
Analysis = Nota Manutenção Ventilador Temperatura do Estator E1M
View/Edit Trigger
Subscriptions
There are currently 1 subscribers to this Notification Rule.
View/Edit Subscriptions
Manage Formats


Notification de Parada da Caldeira - Message - Notificacao
Name
Is Default
Global Default Email
Notificacao
Inherited
Design
HTML Preview
Plain Text Preview
Arial
11
Subject
GPA Alerta: Caldeira
Target:Name
parou
Attachments
Test Send
Event: Event Frame:Name
Ativo: Target:Name
Start Time: Event Frame:Start Time
Severity: Event Frame:Severity
Content
AF Server Properties
Database Properties
Notification Rule Properties
Event Details Hyperlink
Event Frame Properties
Event Frame Attributes PISAP - CriarNotaI
Área
Ativo
Ativo Pai
Caminho PI AF
Consumo Combustível
Descrição
Descrição Teste
DescricaoTeste
Formulário
Local de instalação
Número da nota
Pressão de Vapor
Pressão Tubulão
Prioridade
Produção de Vapor
The selected format is read-only.
OK

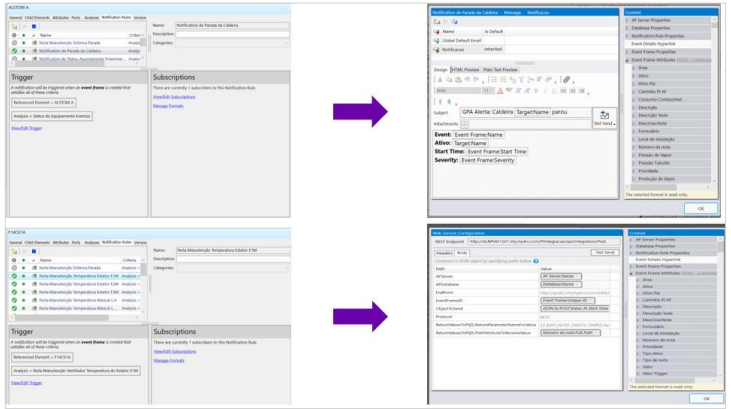

Web Service Configuration
REST Endpoint
http://ALNPIAF1201.nhy.hydro.com/PIIntegracao/api/Integration/Post
Headers
Body
Test Send
Construct a JSON object by specifying paths below
Path
Value
AFServer
AF Server:Name
AFDatabase
Database:Name
EndPoint
http://qxz8ci.nhy.hydro.com:56400/
EventFrameID
Event Frame:Unique ID
ObjectToSend
JSON to POST:Value At Start Time
Protocol
REST
ReturnValuesToPI[0].ReturnParameterNameForValue
['Z_BAPI_NOTIF_CREATE_SIMPLE.Res
ReturnValuesToPI[0].PIAFAttributeToReceiveValue
Número da nota:Full Path
Content
AF Server Properties
Database Properties
Notification Rule Properties
Event Details Hyperlink
Event Frame Properties
Event Frame Attributes PISAP - CriarNotaI
Área
Ativo
Ativo Pai
Caminho PI AF
Descrição
Descrição Teste
DescricaoTeste
Formulário
Local de instalação
Número da nota
Prioridade
Tipo Ativo
Tipo de nota
Valor
Valor Trigger
The selected format is read-only.
OK

Resources

Tools and resources used from AVEVA products

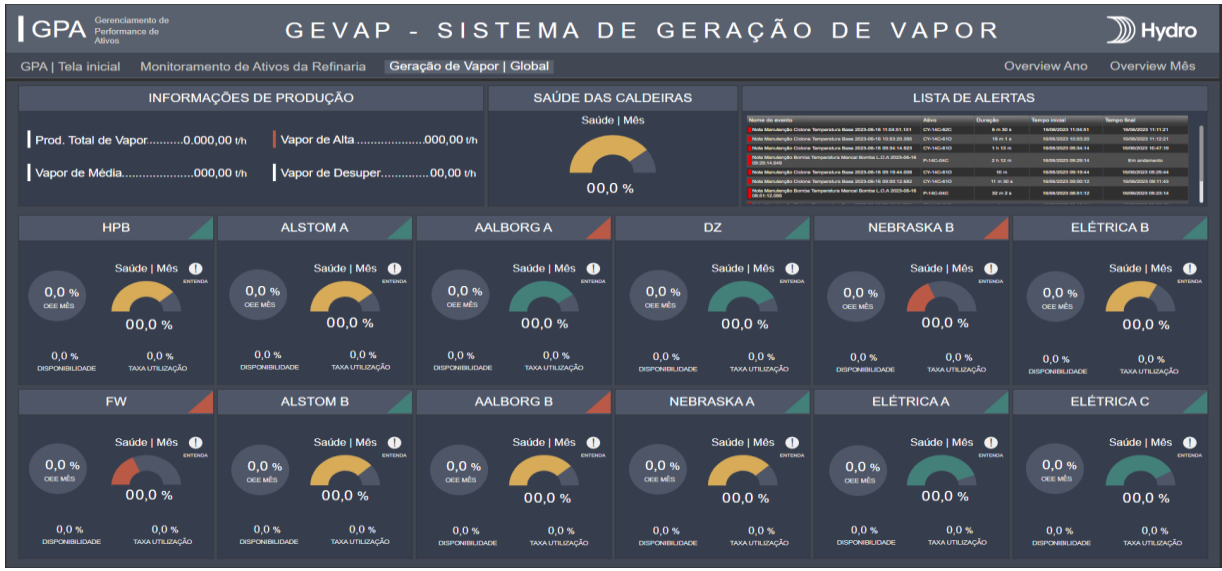
AVEVA PI Notifications as the messaging solution to

- Send email according to the rules of CBM created or prediction results from SQC Analytics;
- Open maintenance notifications on the ERP of Hydro automatically;
- Send periodic reports to the managers with reliability indicators and asset status;



Dashboards for online monitoring on AVEVA PI Vision.


GERENCIAMENTO DE PERFORMANCE DE ATIVOS (GPA)
HYDRO ALUNORTE
Hydro
Geral - GPA
MONITORAMENTO DE ATIVOS DA REFINARIA
SISTEMA DE VAPOR
ÁGUAS E EFLUENTES
DESAGUAMENTO
DIGESTÃO E EVAPORAÇÃO
CLARIFICAÇÃO
00,0 %
SAÚDE GLOBAL
SAÚDE | MALHAS DE CONTROLE
SAÚDE | REVEZAMENTO DE BOMBAS
SAÚDE | MONITORAMENTO DE ATIVOS
SAÚDE | MONITORAMENTO DE BOMBAS
Saiba mais
PRECIPITAÇÃO
CALCINAÇÃO
PORTO
FILTRO PRENSA
DRS


GPA Gerenciamento de Performance de Ativos
GEVAP - SISTEMA DE GERAÇÃO DE VAPOR
Hydro
GPA | Tela inicial
Monitoramento de Ativos da Refinaria
Geração de Vapor | Global
Overview Ano
Overview Mês
INFORMAÇÕES DE PRODUÇÃO
Prod. Total de Vapor.....0.000,00 t/h
Vapor de Alta.....000,00 t/h
Vapor de Média.....000,00 t/h
Vapor de Desuper.....00,00 t/h
SAÚDE DAS CALDEIRAS
Saúde | Mês
00,0 %
LISTA DE ALERTAS
HPB
ALSTOM A
AALBORG A
DZ
NEBRASKA B
ELÉTRICA B
FW
ALSTOM B
AALBORG B
NEBRASKA A
ELÉTRICA A
ELÉTRICA C
OEE MÊS
DISPONIBILIDADE
TAXA UTILIZAÇÃO


GPA Gerenciamento de Performance de Ativos
TELA PRINCIPAL - XXX
Hydro
GPA - Geral → Geração de Vapor → XXX
STATUS: Operação
SAÚDE
00,0 %
Carga .....00,0 %
Produção de Vapor.....00,0 t/h
Consumo Combustível...00,0 t/h
Consumo Específico.....0,0
Sinótico
Parâmetros de Operação
Árvore de Ativos
Equipamentos
Malhas de Controle
Árvore de Falhas
PERFORMANCE DA CALDEIRA
SAÚDE
CONFIABILIDADE
PROB. DE FALHA
INDICADORES DE PERFORMANCE
ANO
MÊS
UPTIME
DOWNTIME
DISPONIBILIDADE
TAXA DE UTILIZAÇÃO
OEE
MTBF
MTTR
PERFORMANCE DE ATIVOS
INSTRUMENTAÇÃO
MALHAS DE CONTROLE
VÁLVULAS DE CONTROLE
BOMBAS
VENTILADORES
DISPONÍVEL:
INDISPONÍVEL:
PERFORMANCE
LISTA DE ALERTAS
MONITORAMENTO DE PARADAS
Nº PARADAS ANO: 00
Nº PARADA MÊS: 0

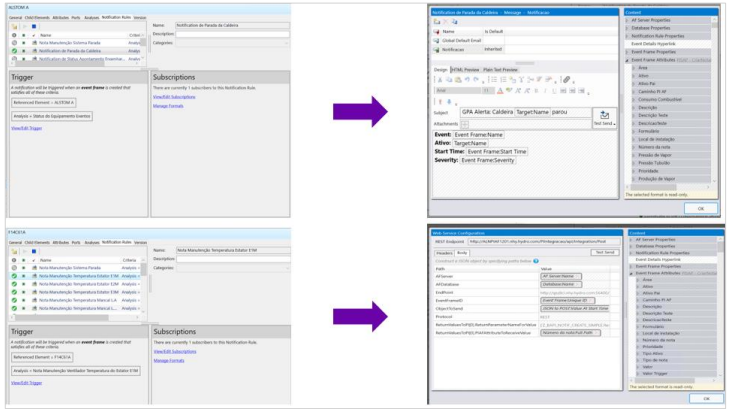

GERENCIAMENTO DE PERFORMANCE DE ATIVOS (GPA)
SINÓTICO - HPB
Hydro
GPA - Geral → Geração de Vapor → HPB → Sinótico
STATUS: Operação
SAÚDE
89,2 %
Carga .....80,0 %
Produção de Vapor.....271,9 t/h
Consumo Combustível....35,8 t/h
Consumo Específico.....7,6
Sinótico
Parâmetros de Operação
Árvore de Ativos
Equipamentos
Malhas de Controle
Árvore de Falhas
E-57D-02
HPB
Carvão Total
35,84 t/h
Cálcario
Temp. Média
MDC
BH
E-57D-91
T-57D
55
Água Ind.
P-57D-4A
P-57D-4B
18/09/2023 09:54:33
8 h
Agora
18/09/2023 17:54:33

Resources

Tools and resources used from AVEVA products

AVEVA PI Notifications as the messaging solution to

- Send email according to the rules of CBM created or prediction results from SQC Analytics;
- Open maintenance notifications on the ERP of Hydro automatically;
- Send periodic reports to the managers with reliability indicators and asset status;



Dashboards for online monitoring on AVEVA PI Vision.

GPA Gerenciamento de Performance de Ativos

DESAGUAMENTO - FILTROS HIPERBÁRICOS

Hydro

GPA | Tela inicial | Filtros Hiperbáricos | Área 03C | Filtro 3

FILTRO 2 ◀ **FILTRO 3** ▶ FILTRO 4

PERFORMANCE

UPTIME	DISPONIBILIDADE	OEE	DOWNTIME	TAXA UTILIZAÇÃO	MTBF	MTTR
9,5 h	80,0 %	9,0 %	3,5 h	95,7 %	2,1 h	0,5 h

PRODUÇÃO

- 461 t — DIFERENÇA (Ritmo - Potencial)
- 2.197 t — PROJEÇÃO (Realizado + Meta)
- 90 ton/h — TAXA RECUPERAÇÃO

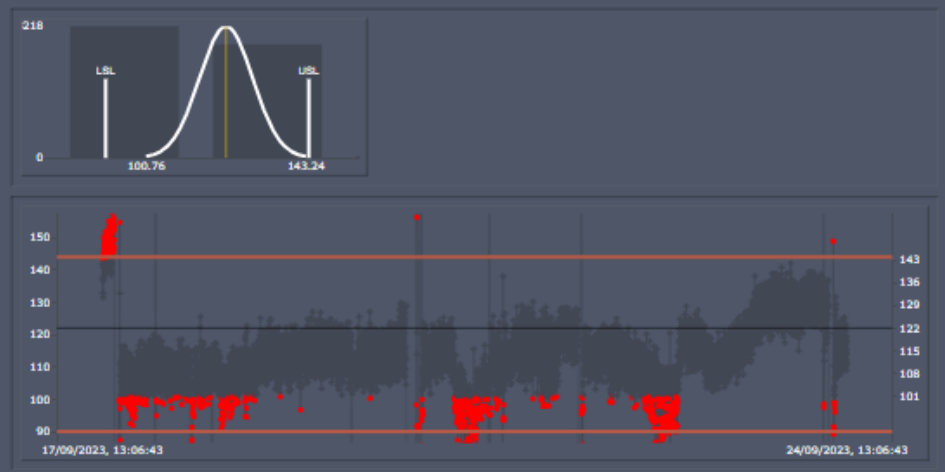
POTENCIAL 2.342 t | 2.804 t RITMO | FORECAST 1.969 t

PERÍODO DE ANÁLISE

DIA | MÊS | ANO

FILTRO EM OPERAÇÃO

SQC CONTROLE ESTATÍSTICO DE QUALIDADE
STATISCAL QUALITY CONTROL



PARÂMETROS

- PIC-03C-118 (5,8 ~ 6,2 bar) AUTO 5,6
- Consumo de ar (3300 ~ 4200 Nm³/h) ..... 5.299 Nm³/h
- Passos de 1 a 14 - Tempos Descarga ..... ON
- PIC03C117 (6 ~ 7) AUTO 6,0
- SIC03C101 (>= 2 RPM) AUTO 2,0
- LIC03C101 (> 90%) AUTO 87,8
- AT03C102 | Clarificador sol. (<100 um) ..... 5,5 mg/L
- DT03C014 | Densidade entrada (1,45 ~ 1,47) ..... 1,44 g/cm³
- HV-03C-125 "Aberta" & PT-03C-104 (>= 6) ..... TRUE
- P-03C-5 | Status (= 1) 1
- A03C1 "Ligado" & Nível Tanque 4 (75 ~ 80) ..... TRUE
- Filtrado (<= 100) ..... 700,0 ml/L
  Operação FORA do range | Tempo acumulado: 10,4 horas
- Umidade (<= 14,5) ..... 14,5 %

1
N° paradas

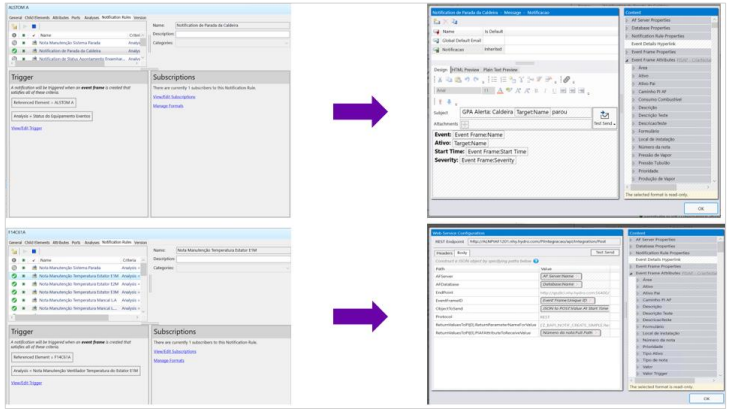
FILTRO Últimos 3 desarmes	24/9 7:22 - XA_03C_001yK-F3 22/9 4:15 - Pressao baixa no filtro (PT_03C_118y)-F3 21/9 7:33 - Vazao ar de processo alta (FT_03C_113yK)-F3
AGITADOR Último desarme	Nível Baixo do T-03-4

Resources

Tools and resources used from AVEVA products

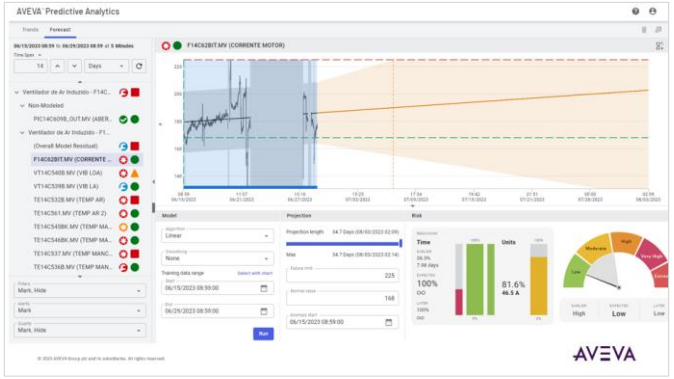
AVEVA PI Notifications as the messaging solution to

- Send email according to the rules of CBM created or prediction results from SQC Analytics;
- Open maintenance notifications on the ERP of Hydro automatically;
- Send periodic reports to the managers with reliability indicators and asset status;



Dashboards for online monitoring on AVEVA PI Vision.

Predictive approach on 4 assets through AVEVA Predictive Analytics



Results

Achieved Results

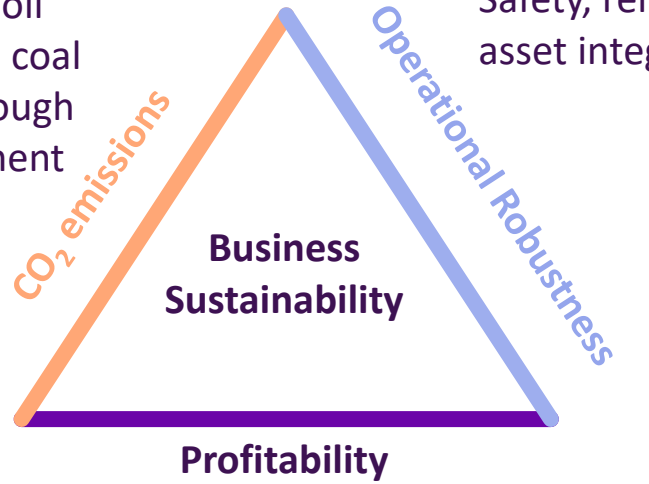
+50

Early interventions within a one-year period

+$4.7M

Avoided Cost

Reduction in BPF oil consumption and coal consumption through improved equipment efficiency



Safety, reliability, and asset integrity

Increasing and monitoring process efficiency

Maintenance Cost	Asset Scrapping	Production Loss	Health, Safety and Environment
$2.2M	$1.3M	$1.2M	High Risk

Conclusion

How the right partnership can accelerate your results

Historical data on asset behavior, combined with process knowledge and best maintenance practices, along with technological advancements, are fundamental components for the development and growth of the industries.

From the development of the first proof of concept, we already believed in the feasibility of the solution. The engagement of various partners (maintenance area, production area, IT, automation) showed us how we could move faster and further.

Pedro Henrique Moura Costa

Sr. System Specialist

Norsk Hydro Brazil
Pedro.costa@hydro.com

Sandy Caroline Azevedo Lopes

Reliability Engineer

Norsk Hydro Brazil
Sandy.lopes@hydro.com

Rafael Cruz

Project Manager

Radix Engineering & Software
Rafael.Cruz@radixeng.com

Questions?

Please wait for the microphone.

State your name and company.

Please remember to…

Navigate to this session in the mobile app to complete the survey.

Thank you!

This presentation may include predictions, estimates, intentions, beliefs and other statements that are or may be construed as being forward-looking. While these forward-looking statements represent our current judgment on what the future holds, they are subject to risks and uncertainties that could result in actual outcomes differing materially from those projected in these statements. No statement contained herein constitutes a commitment by AVEVA to perform any particular action or to deliver any particular product or product features. Readers are cautioned not to place undue reliance on these forward-looking statements, which reflect our opinions only as of the date of this presentation.

The Company shall not be obliged to disclose any revision to these forward-looking statements to reflect events or circumstances occurring after the date on which they are made or to reflect the occurrence of future events.

linkedin.com/company/aveva

@avevagroup

ABOUT AVEVA

AVEVA is a world leader in industrial software, providing engineering and operational solutions across multiple industries, including oil and gas, chemical, pharmaceutical, power and utilities, marine, renewables, and food and beverage. Our agnostic and open architecture helps organizations design, build, operate, maintain and optimize the complete lifecycle of complex industrial assets, from production plants and offshore platforms to manufactured consumer goods.

Over 20,000 enterprises in over 100 countries rely on AVEVA to help them deliver life's essentials: safe and reliable energy, food, medicines, infrastructure and more. By connecting people with trusted information and AI-enriched insights, AVEVA enables teams to engineer efficiently and optimize operations, driving growth and sustainability.

Named as one of the world's most innovative companies, AVEVA supports customers with open solutions and the expertise of more than 6,400 employees, 5,000 partners and 5,700 certified developers. The company is headquartered in Cambridge, UK.

Learn more at www.aveva.com

AVEVA