



**Intelligence  
for Tomorrow**

Financiado por:

**CENTRO 2020** **PORTUGAL 2020**  UNião Europeia  
Fundo Europeu  
de Desenvolvimento Regional

 AGÊNCIA NACIONAL  
DE INOVAÇÃO

**enging.pt**

**ENGING**

**EPAL**  
Grupo Águas de Portugal


**MONITORIZAÇÃO DA CONDIÇÃO DE MOTORES  
ELÉTRICOS E EFICIÊNCIA DE BOMBAS**


**INTRODUCTION**

**PROJECT BACKGROUND - OVERVIEW**


- Enging has developed the MCM solution – Motor Condition Monitoring for electric motors
- It has gain the financial support from European Commission in the background of H2020
- MCM solution is now being used worldwide with great success
- For the Water Sector, there was a need of a combined solution for motor and pump monitoring
- Enging applied to PT2020 with a new project for complete monitoring of pumping systems


**ENGING**  
MCM SOLUTIONS

 European  
Commission

 SMEs in

Financiado por:

**CENTRO 2020** **PORTUGAL 2020**  UNião Europeia  
Fundo Europeu  
de Desenvolvimento Regional

 AGÊNCIA NACIONAL  
DE INOVAÇÃO

## INTRODUCTION

### PROJECT BACKGROUND – MAIN OBJECTIVES

- Develop dedicated hardware to acquire both motor electric signals but also the different hydraulic parameters (flow, pressure, height)
- Implement the required mathematics to calculate pump parameters (pumping head, hydraulic power, pump efficiency)
- Find a company in water sector to install the prototype for demonstration
- Integrate all data in the existing Enging's ePreditMntc monitoring platform

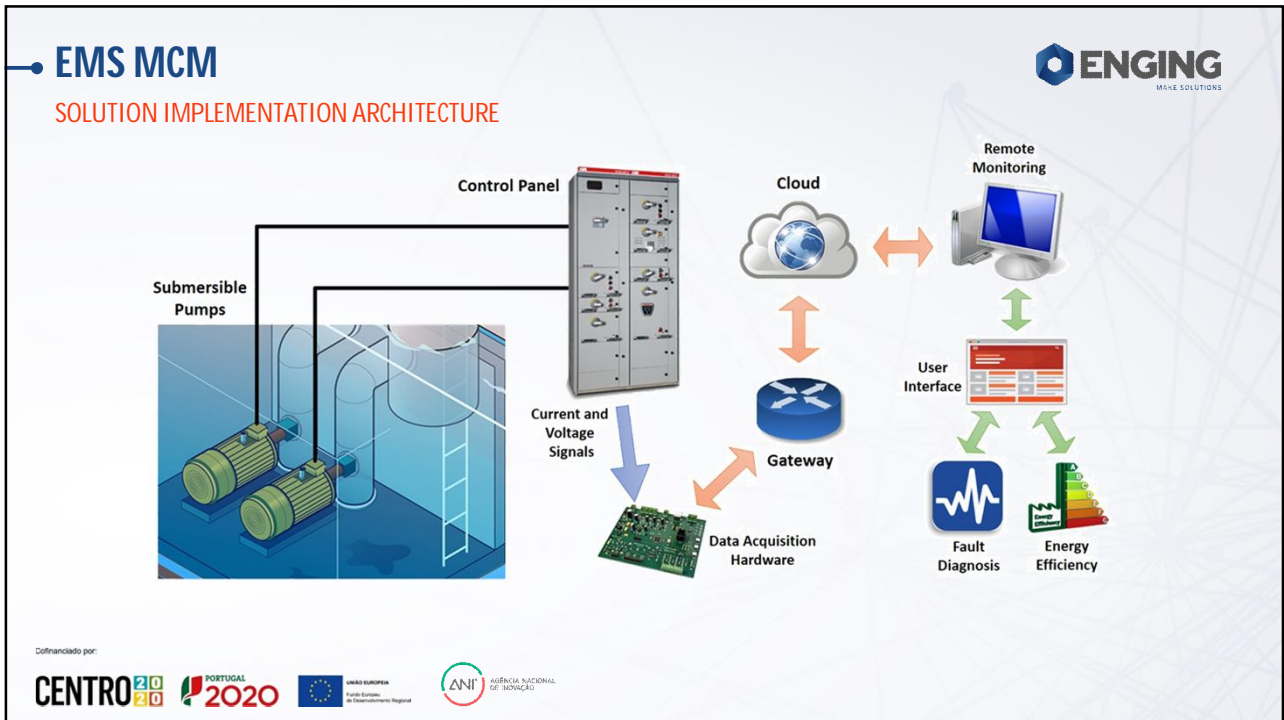
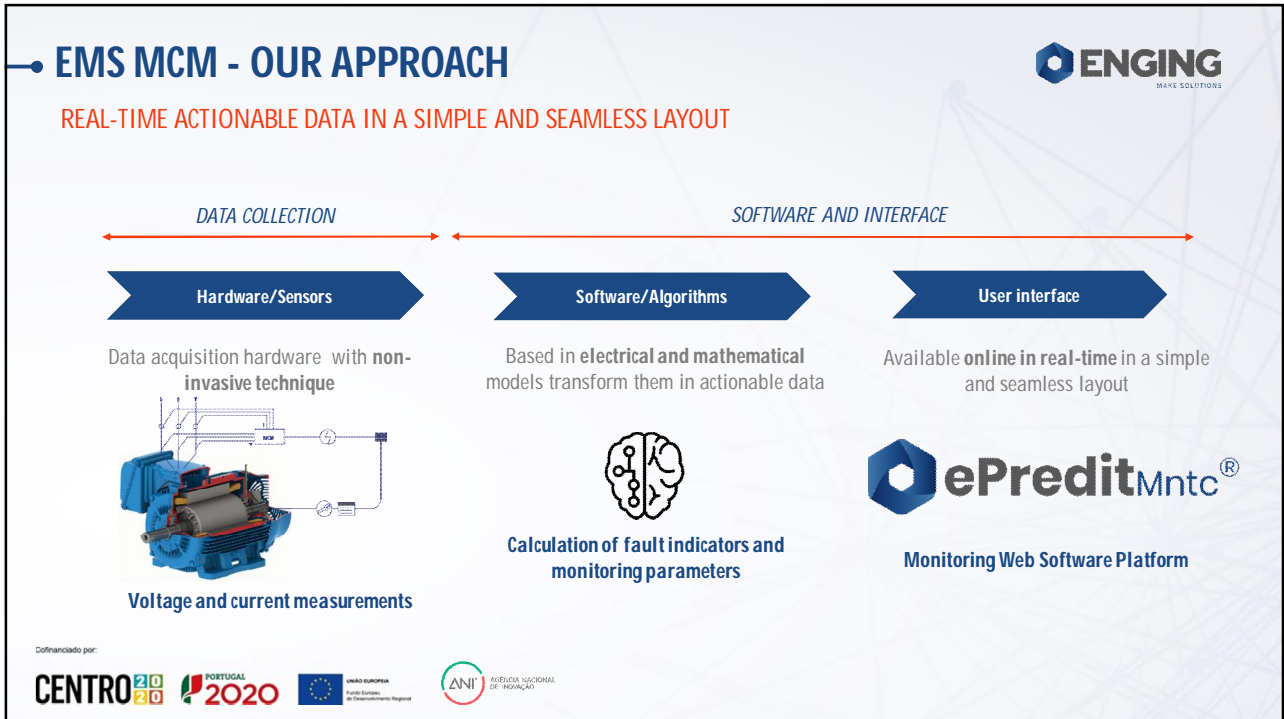


Cofinanciado por:



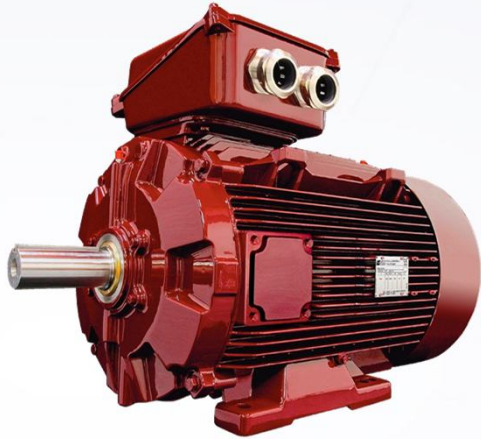
CONDITION MONITORING for  
**ELECTRIC MOTORS**  
**EMS MCM**





## EMS MCM

### APPLICATIONS



- ◆ THREE-PHASE MOTORS
- ◆ LOW OR MEDIUM VOLTAGE
- ◆ ASYNCHRONOUS / SYNCHRONOUS
- ◆ WITH / WITHOUT VARIABLE SPEED DRIVE

Co-financiado por:



## EMS MCM

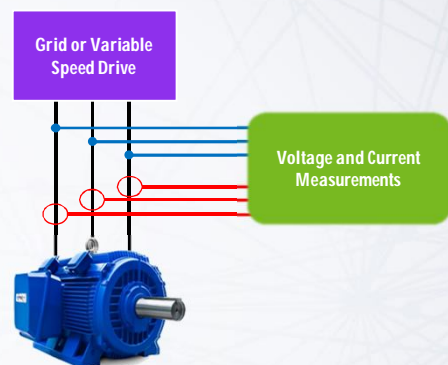
### SOLUTION DESCRIPTION

#### ONLINE CONTINUOUS MONITORING:

- ◆ 10 second of data acquisition (2500 points/second)
- ◆ Periodicity from 2 minutes to hours

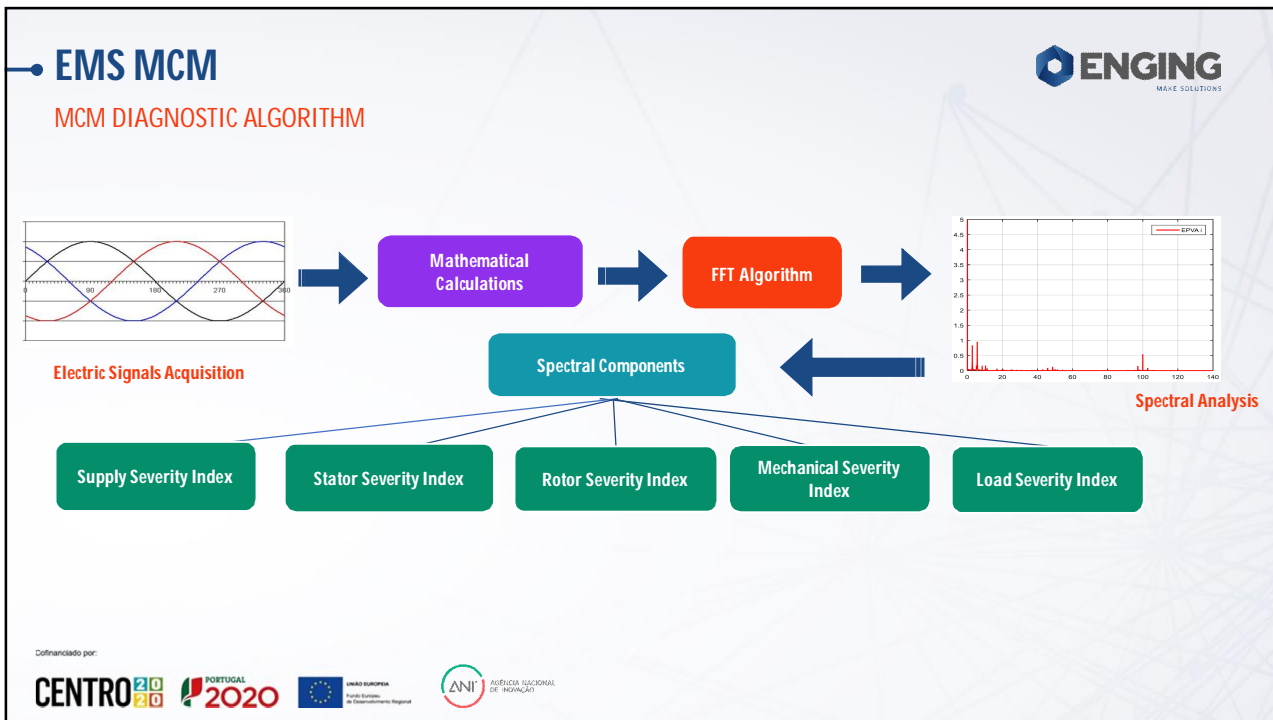
#### ALGORITHM CALCULATIONS:

- ◆ Electric parameters (voltage, current, power, THD, etc...)
- ◆ Mechanical parameters (speed, slip, shaft power, efficiency)
- ◆ Instantaneous vector analysis
- ◆ Advanced power analysis



Co-financiado por:





## EMS MCM

### EPREDITMNTC MONITORING PLATFORM

#### Main Dashboard

- Global view of all motors
- Overall condition based on traffic light colors
- Sort based on motor condition

Financiado por:

CENTRO 2020

PORTUGAL 2020

UNIAO EUROPEIA

ANP

AGENCIA NACIONAL DE INOVACAO

# EMS MCM

## EPREDITMNTC MONITORING PLATFORM



### Control Panel

- Main electrical and mechanical variables
- Power quality parameters
- Vector diagram
- Electrical waveforms display

Co-financiado por:



# EMS MCM

## EPREDITMNTC MONITORING PLATFORM



### Diagnostic Panel


- Trend of main diagnostic indicators
- Spectral analysis
- Time-domain analysis
- Advanced harmonic analysis

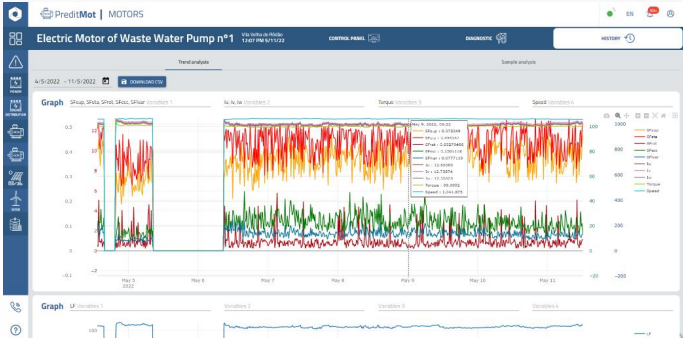
Co-financiado por:



## EMS MCM

### EPREDITMNTC MONITORING PLATFORM









### History Panel

- Visualization of all computed variables
- Multiple y-axis graphs
- Custom time period range selection
- Data exportation features

Cofinanciado por:

## CONDITION MONITORING for ELECTRIC MOTORS

### EMS MCM





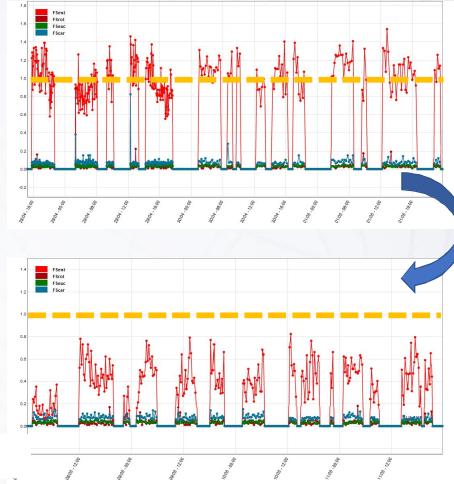
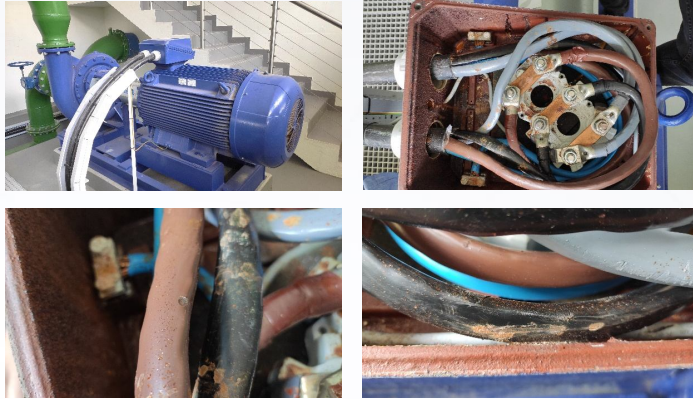


## CASE STUDIES

## EMS MCM – CASE STUDIES



### CASE 1 – MOTOR PUMP WITH STATOR WINDING INSULATION ISSUES



Stator condition indicator decreased after fixing terminal box/cables problems

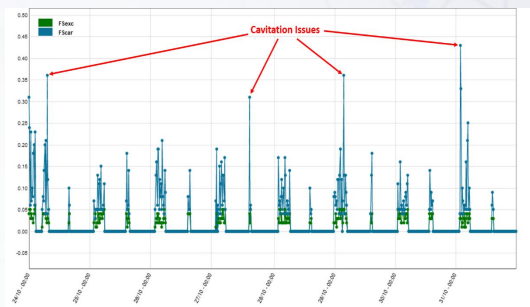
Financiado por:



## EMS MCM – CASE STUDIES



### CASE 2 – PUMP CAVITATION



Load variation indicator with frequent peaks due to cavitation


Financiado por:



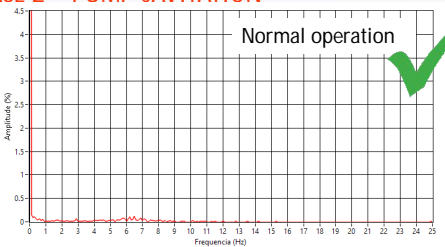


## EMS MCM – CASE STUDIES

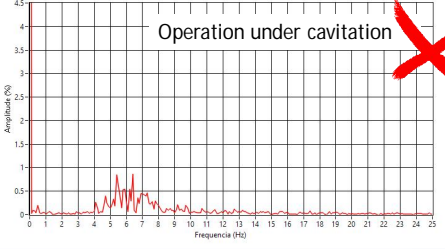
**CASE 2 – PUMP CAVITATION**

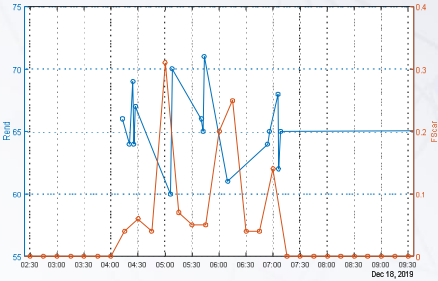


**Normal operation** ✓







**Operation under cavitation** ✗






Overall, pump efficiency (blue curve) is lower when ePredictMntc (orange curve) detects peaks of higher load variation (cavitation)


Dofinanciado por:


## EMS MCM – CASE STUDIES

**CASE 3 – MOTOR PUMP WITH MECHANICAL PROBLEMS**









**Repairing**

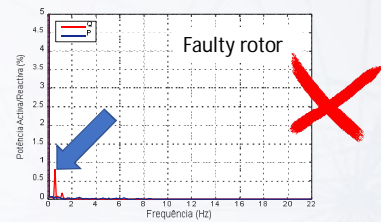
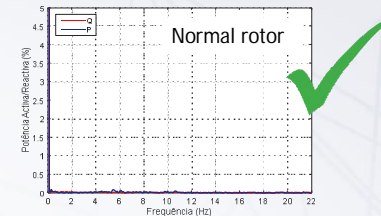


Dofinanciado por:

## EMS MCM – CASE STUDIES

### CASE 4 – MOTOR PUMP WITH ROTOR BROKEN BARS



Data obtained from a health checkup service – single measurement/sample

Financiado por:



## EMS MCM – CASE STUDIES

### CASE 4 – MOTOR PUMP WITH ROTOR BROKEN BARS



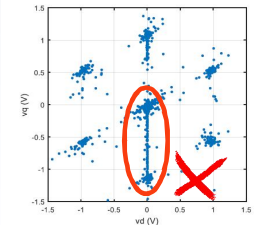

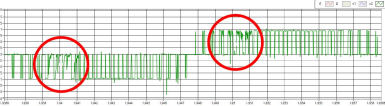

Rotor with visible degradation signs and some broken bars

Financiado por:





**EMS MCM – CASE STUDIES**

**CASE 5 – MOTOR PUMP WITH INVERTER PROBLEMS**

Intermittent switching problems in the internal elements of power and/or control electronics.

Co-financiado por:

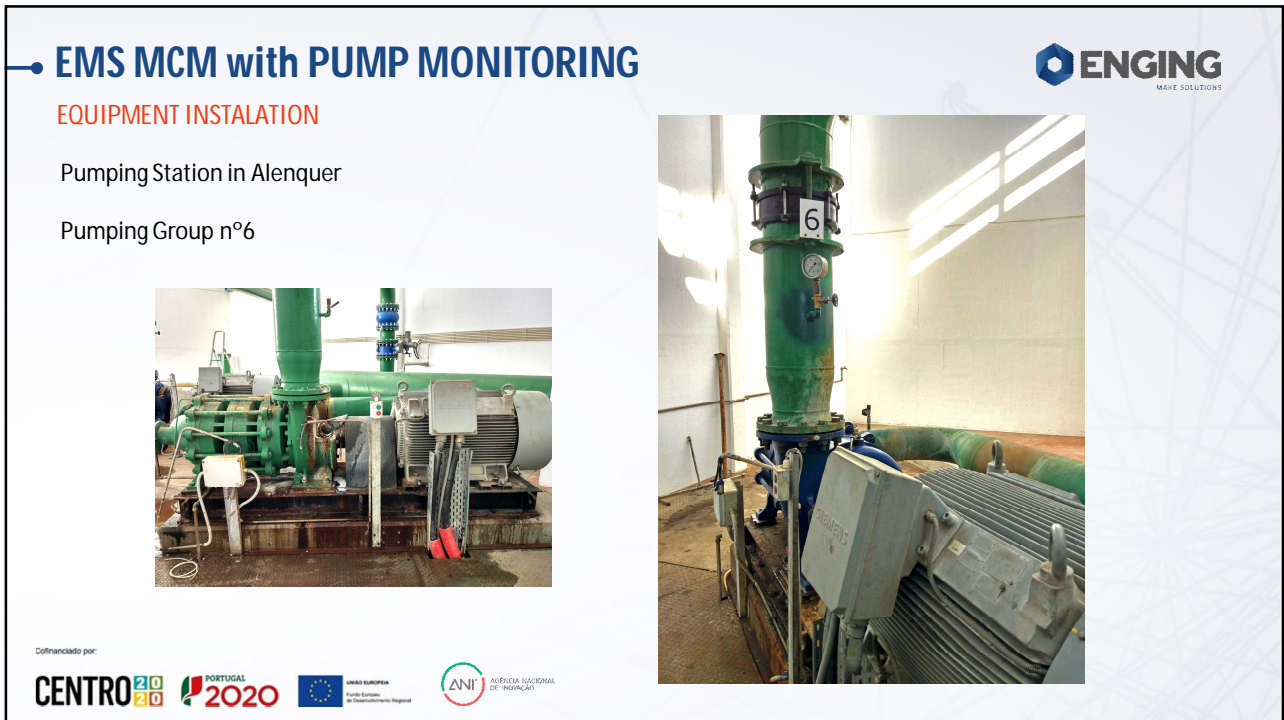
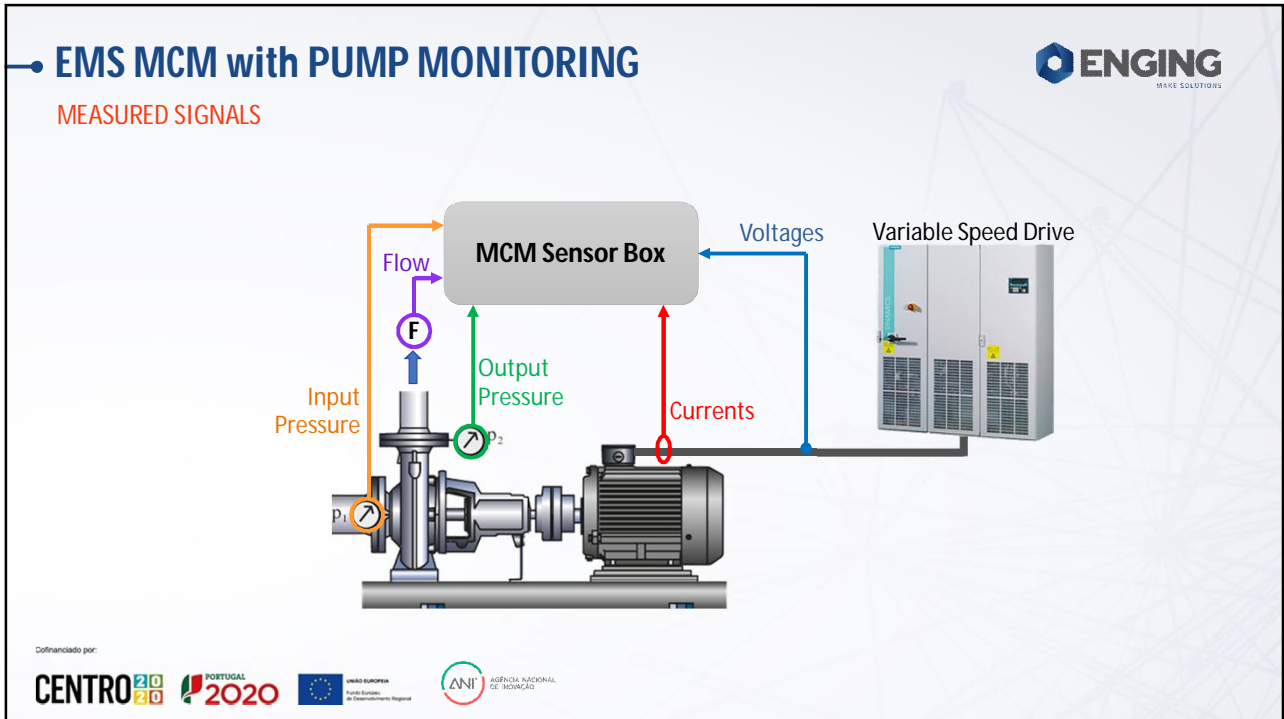



CONDITION MONITORING for  
**ELECTRIC MOTORS**

**EMS MCM with PUMP MONITORING**





## EMS MCM with PUMP MONITORING

EQUIPMENT INSTALLATION

Financiado por:

**CENTRO 2020** **PORTUGAL 2020** **UNIAO EUROPEIA** **ANP** **AGENCIA NACIONAL DE INOVACAO**

## EMS MCM with PUMP MONITORING

MAIN RESULTS

- The motor drive condition is fully characterized based on the trends of the main fault indicators
- Globally it is operating fine although it can be seen that sometimes, the stator indicator rises above the warning limit
- This is caused by the internal converter control because supply indicator (related to VFD) also has same behavior

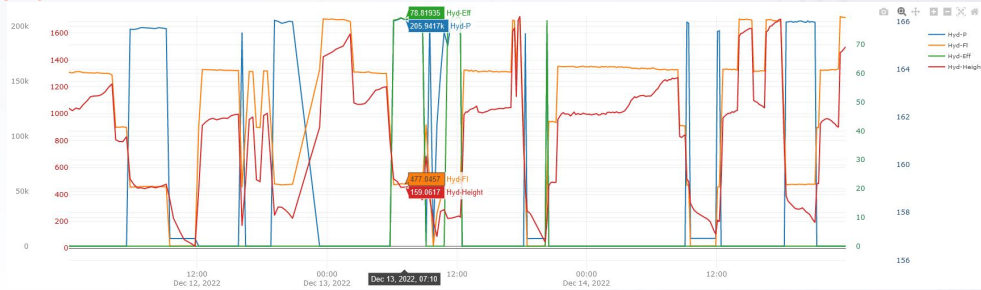
Financiado por:

**CENTRO 2020** **PORTUGAL 2020** **UNIAO EUROPEIA** **ANP** **AGENCIA NACIONAL DE INOVACAO**

## EMS MCM with PUMP MONITORING



### MAIN RESULTS



- Visualization of all hydraulic parameters measured in the field
- Calculation of all relevant pump parameters: pumping head, hydraulic power, pump efficiency
- Easy and direct correlation of all data in a single monitoring platform
- Possibility to fully characterize the pumping system operation with all motor and pump data

Financiado por:

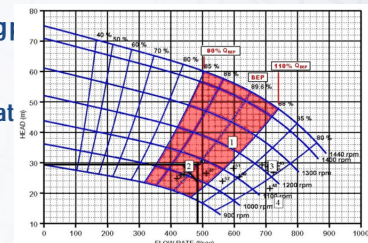


## EMS MCM with PUMP MONITORING



### NEXT STEPS

- Improve ePreditMntc layout interface with more focus on pump monitoring
- Make available the pump operating curves in order to show the best efficiency operating
- Improve the system versatility to be easily configured for any type of pumping system dat



Financiado por:



## FINAL REMARKS



### CONCLUSIONS

- ePreditMntc monitoring platform for electric motors
- Dynamic and deterministic modeling of the assets under monitoring
- Reliable and immediate diagnostic without need of historical data, training periods or periodic adjustments
- Fully automated diagnostic with alarm generation
- Possibility to fully characterize the pumping system operation with all motor and pump data
- Clear understanding of the Best Efficiency Point (BEP)

Cofinanciado por:



## FINAL REMARKS



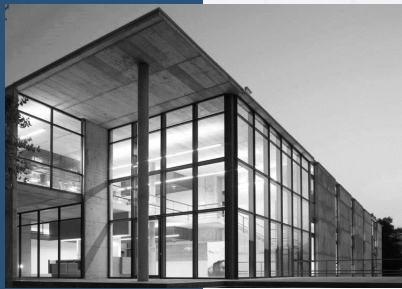
### ACKNOWLEDGMENTS



Cofinanciado por:



CENTRO-01-0247-FEDER-072322



# Get in touch with us!

Address: Instituto Pedro Nunes Edifício C, Sala 0.02

Rua Pedro Nunes 3030-199 Coimbra

Phone: +351 239 099 647

E-mail: [geral@enging.pt](mailto:geral@enging.pt)

[www.enging.pt](http://www.enging.pt)

Follow us:



Co-financiado por:

