



# *Maintenance Specificities in the CERN Cooling and Ventilation Group*

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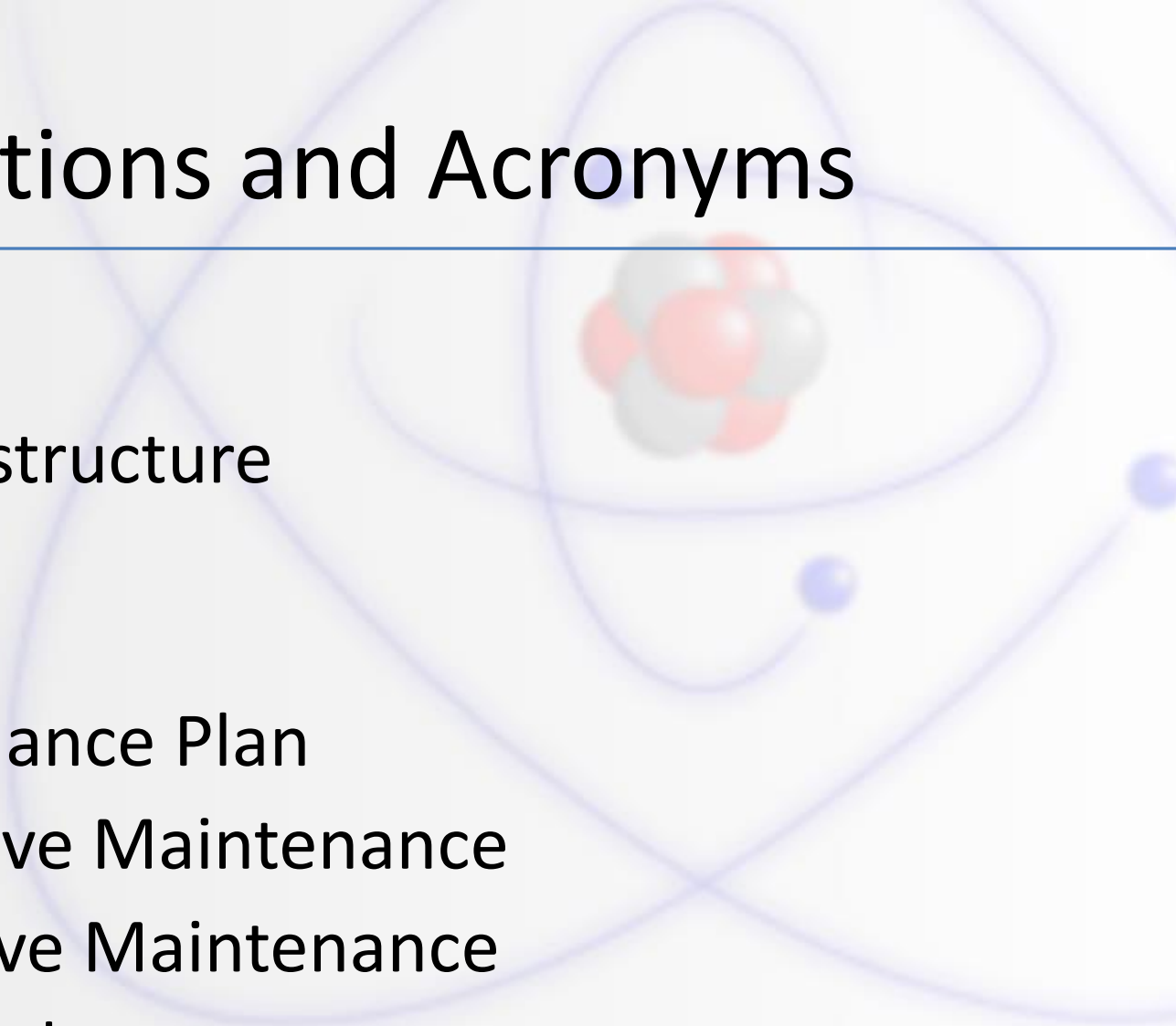
Asset and Maintenance Management Workshop  
CERN, 13-15 November 2013

# Summary



- Definitions and Acronyms
- Introduction to EN/CV
- Overview of EN/CV Maintenance
- CMMS in EN/CV
- Key Performance Indicators
- Meter Readings
- Conditional Maintenance
- Summary
- Conclusions

# Definitions and Acronyms



- Position
- Hierarchical structure
  - Parent
  - Child
- MP: Maintenance Plan
- PM: Preventive Maintenance
- CM: Corrective Maintenance
- WO: Work Order



# Introduction to EN/CV

The CV group is responsible for the CERN  
*Cooling and Ventilation*  
installations:

ACCELERATORS

DETECTORS

EXPERIMENTAL  
AREAS

COMPUTER  
CENTER

DESIGN

WORKS

OPERATION

MAINTENANCE

# Introduction to EN/CV

## HVAC:

- Tunnel
- Experimental caverns
- Service caverns
- Pressurized safe areas
- Surface “machine” buildings
- Smoke and Gas Extraction Systems

Compressed air systems

Electricity  
Control and supervision systems

## Water Systems:

- Primary water
- Demineralised water
- Chilled water
- Mixed water
- Reject water
- Sanitary water
- Fire fighting water

**A total of  
76000  
pieces of equipment**

# Cooling and distribution

Cooling towers (450 MW)	22
Chilled water production : 6-12°C (73 MW)	35
Cooling plants (raw water, demineralized water, C <sub>3</sub> F <sub>8</sub> , C <sub>6</sub> F <sub>14</sub> )	150
Distribution Pipework	800 km
Total water consumption	5'400 m <sup>3</sup> /h

*Equivalent to 10%  
consumption Geneva  
Canton*



# Ventilation, Fluid Systems

HVAC	1'500 units
Fire fighting systems	from 2'000 to 120'000 m <sup>3</sup> /h per unit
Compressed air	800 points
Demineralised water production	14 installations
	distribution network 200 km
	20 m <sup>3</sup> /h - 0.1 μS/cm



13/Nov/2013

AMMW2013

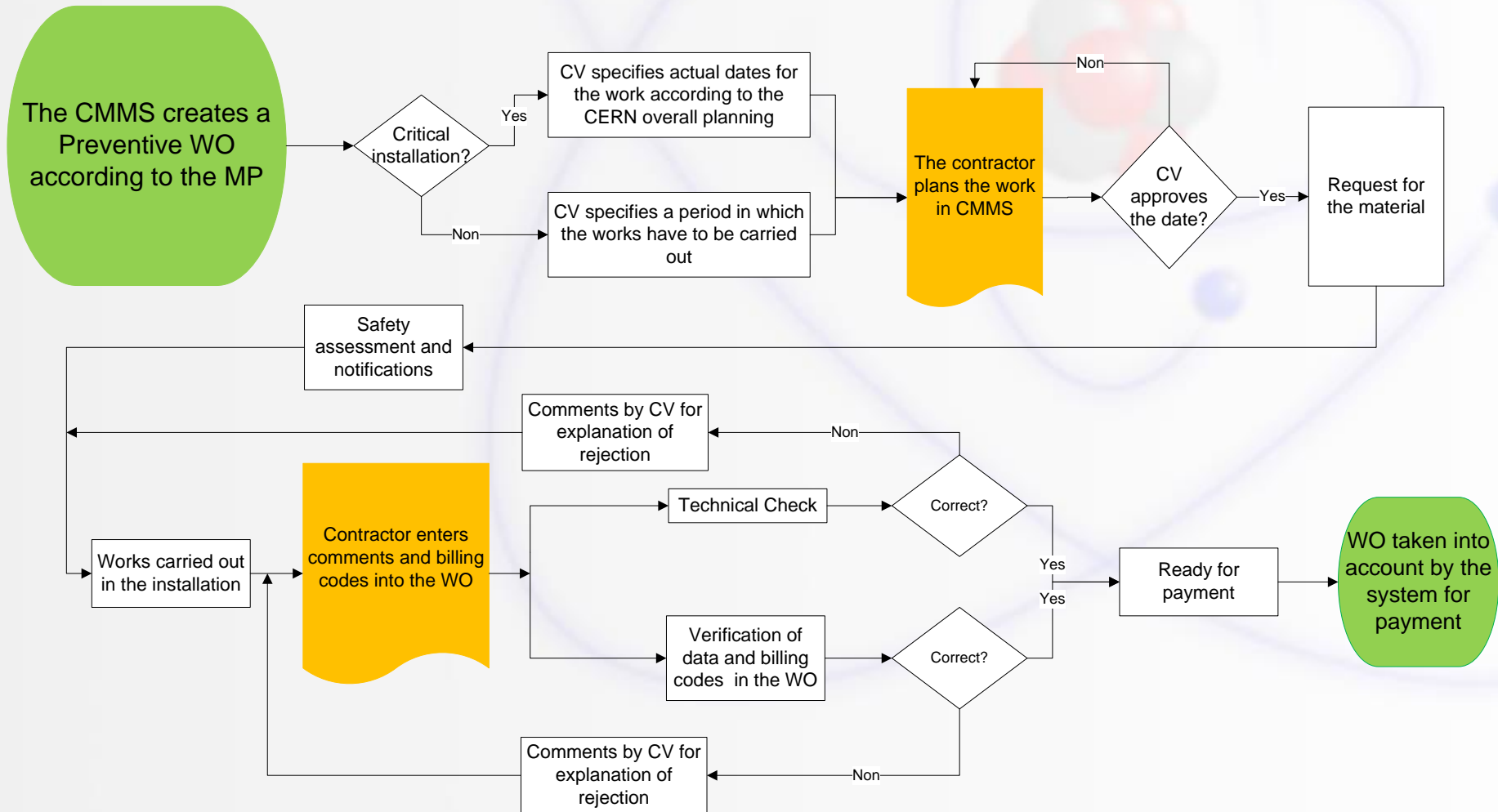
CLOUD EXPERIMENT  
Josa F. Nov 2009



# Overview of EN/CV Maintenance

- The general activities are covered by just two contractors
- Other particular activities are assigned to specialised contractors, i.e. water treatment
- Their work is divided in geographical areas
  - PS complex plus 50% of the LHC installations
  - SPS complex plus 50% of the LHC installations
- Stand by interventions:
  - PS, SPS: Contractors
  - LHC, CERN Computing Centre: CERN
- Maintenance Budget of 6MCHF/yr
- *Asset Value* of 600MCHF

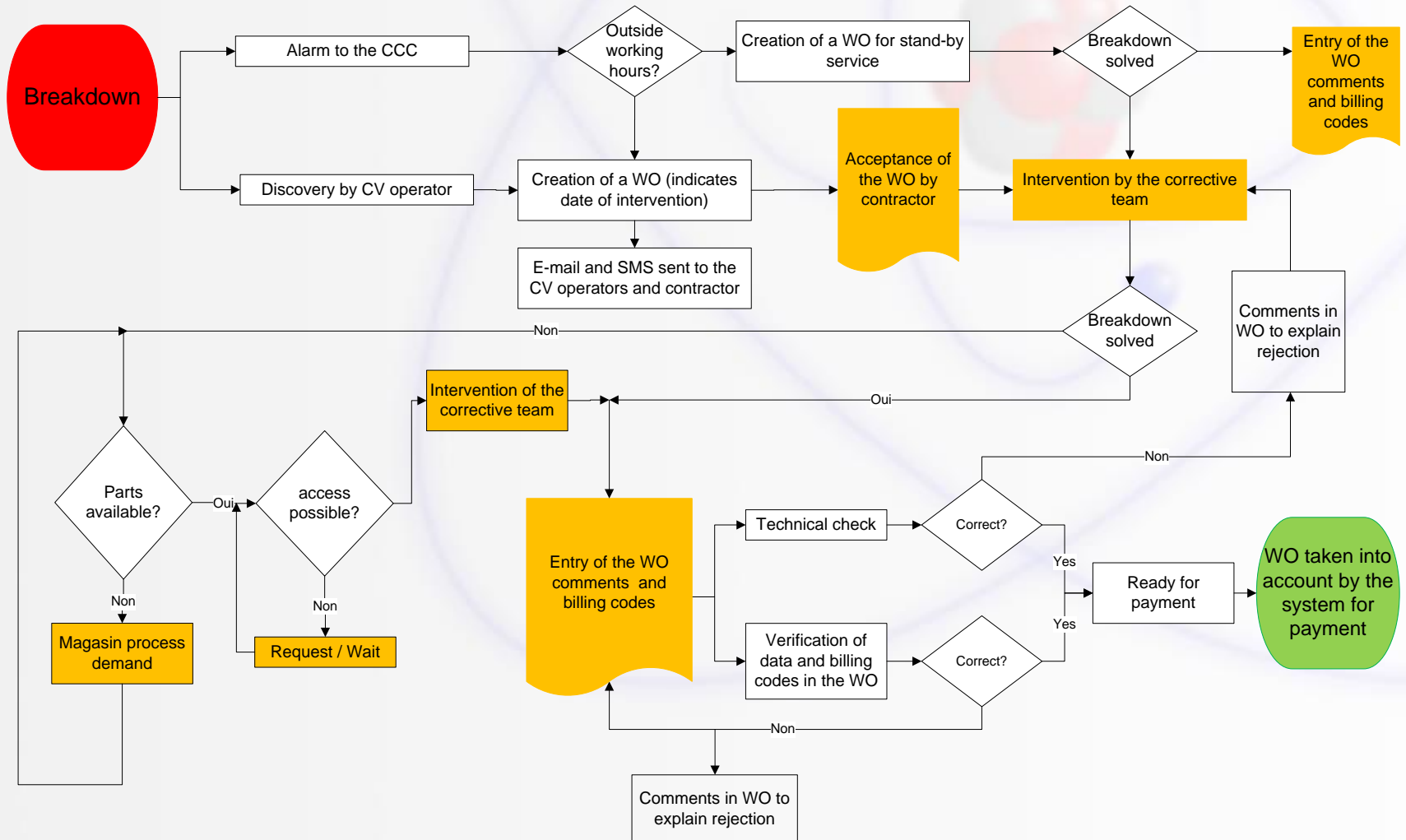
# Organisation of the Preventive Maintenance



# Preventive Maintenance Maintenance Plans

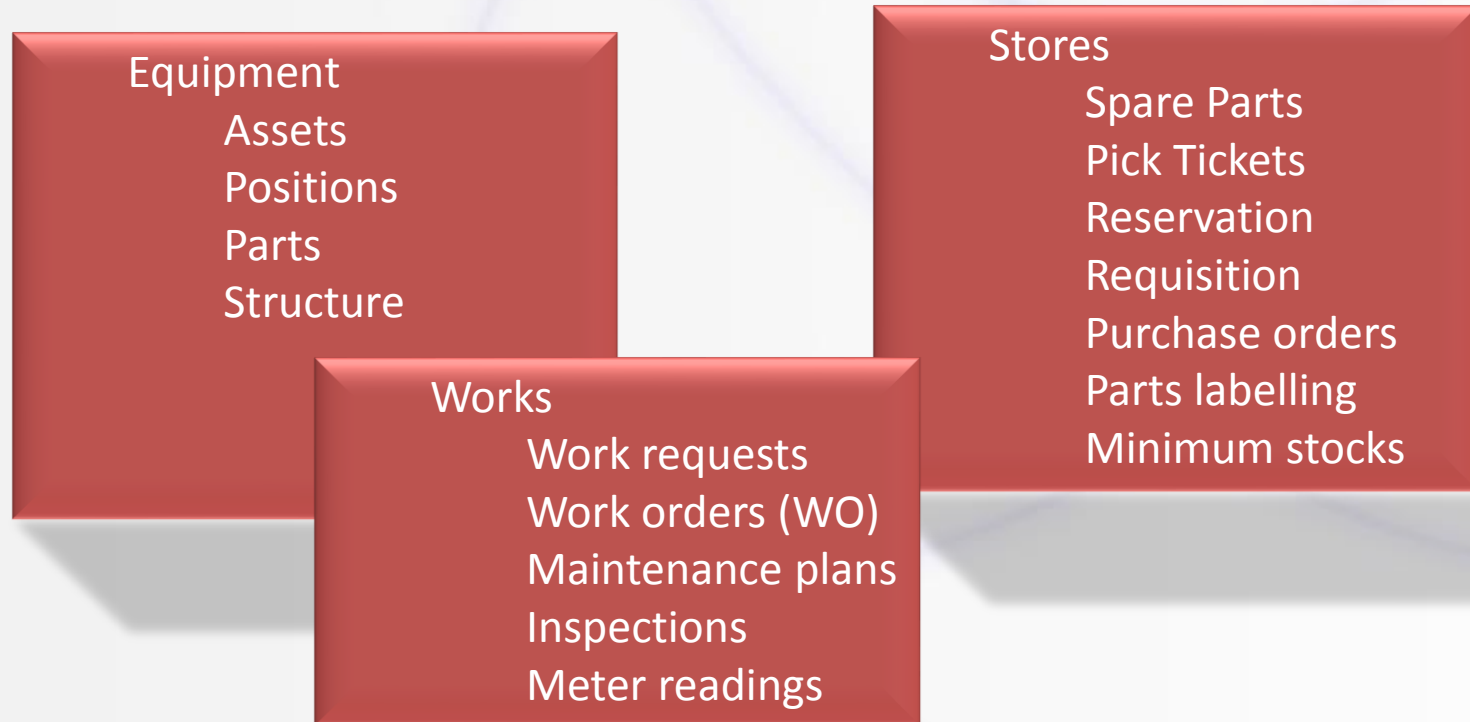
- MPs generates WOs at the level of the Parent
- The WOs point to *Maintenance Procedures* according to the equipment installed within the Parent
- The MPs automate provisional WO start and end dates

# Organisation of the Corrective Maintenance



# CMMS in EN/CV

- CV utilizes mainly the following modules in INFOR EAM



# Information in the WOs

## Dates in WOs

Filled by the system

Event date: date of WO creation

Filled by CV personnel

Requested start date  
Requested end date

Filled by contractors' personnel

Schedule start date  
Schedule end date  
Actual start and end dates  
Request and delivery of spares

## Other Information:

Filled by CV personnel

Information to assess the work

Contact person

Particular safety issues

Filled by contractors' personnel

«Assigned to»

Booked hours for a particular employee and day

Description of the work done

Spare parts used

Tests carried out

...

ODM information

Enter ODM: 19468077

SEARCH

edit ODM with WebMMS

edit ODM with InforEAM

edit ODM with EAM Light

JOB CARD

Work Order: 19468077 demande pour changer le pressostat

Created by: FJUBAN

Location: SUX5 Equipment: FRPDSH-00009 Pressostat Differentielle 0.05..1.2 bar (PDSH 5442)

Date Created: 28-JUN-13

MRC: FCP1 Jobtype: CA UDF3: - Safety: -

Status: IP

Type: JOB PM code: - Work Package: - Project: -

Class: -

Priority: \* Criticality: H Parent WO: - Standard WO: -

Event Date: 28-JUN-13

Action Code: - Failure Code: - Cause Code: -

Material available: -

SCHEDULING

Date Reported: 28-JUN-13 Reported by: JUBAN FREDERIC LOUIS 79952 165669 (73490) Assigned by: - Assigned to: HIRSESCU OVIDIU 7XXXX 169247 (95881)

Original Due Date: - Req. Start Date: 01-JUL-13 Sched. Start Date: 01-JUL-13 Sched. End Date: 05-JUL-13 Req. End Date: 05-JUL-13

Start Date: 05-JUL-13 Date completed: 30-JUL-13 Date Updated: 13-AUG-13 Updated by: FJUBAN

ODM COMMENTS

User Info

Comment Text

Created: 28-JUN-13 by FJUBAN

suite a entretien entreprise trane , ils ont decouvert que le pressostat ne fonctionne plus.  
demande pour changer le pressostat .  
me prevenir avant intervention .

Created: 05-JUL-13 by BCHOLLAT

Pick Ticket 14182

Created: 05-JUL-13 by BCHOLLAT

05/07/2013  
Releve de references sur site  
Recherche CVDB et commande INFOR  
En cours

Created: 29-JUL-13 by BCHOLLAT

29/07/2013  
Appro materiel au 939  
Acces installations  
Appel CCC  
Consignation electrique du pressostat  
Depose et decablage du pressostat HS  
Echange, preparation, montage, raccordement, cablage du nouveau pressostat  
Reglage et controle de fonctionnement  
Essai concluant  
Installation laissee en mode automatique  
Rangement materiel  
Appel CCC  
Intervention terminee

BOOKED HOURS

Person	Date	booked hours	MRC	Trade	Activity	Rate	Cost
<u>CHOLLAT-NAMY BRUNO GERARD YVON 7XXXX 162878</u>	05-JUL-13	3	FCP1	EEM	5	0	0
<u>CHOLLAT-NAMY BRUNO GERARD YVON 7XXXX 162878</u>	29-JUL-13	2.5	FCP1	EEM	5	0	0
<u>COUDURIER CURVEUR FREDERIC 7XXXX 165980</u>	29-JUL-13	2.5	FCP1	EEM	5	0	0
<b>report total:</b>		<b>8</b>					

row(s) 1 - 3 of 3

PARTS USED

Trl Store	Trl Part	Par Desc	Trl Qty	Trl Date	Trl Price	Pcost	Trl Trans	Trl Line	Trl Type	Trl Act
F094	<u>F4P3063</u>	FINSES01 - PRESSION	1	30-JUL-13	64.28	64.28	577051	5	I	5
<b>Trl Store Total:</b>						<b>64.28</b>				
F006	<u>F12-08-011</u>	BARKSDALE Pressostat DPD1T-M18SS 0.020...1.20 BAR ref A012463	1	29-JUL-13	714.00	714.00	576698	5	I	5
<b>Trl Store Total:</b>						<b>714.00</b>				
<b>report total:</b>						<b>778.28</b>				

row(s) 1 - 2 of 2

AUDIT VALUES

Ava Changed	Ava From	Ava To	Ava Modifiedby	Ava Function	Reason
<u>FRI_28-JUN-2013 13:41:45</u>	-	2013-07-01 00:00	FJUBAN	-	21-REQU. START change
<u>FRI_28-JUN-2013 15:35:11</u>	2013-06-28 00:00	2013-07-01 00:00	TABACHI	-	7-SCHED.START DATE change
<u>FRI_28-JUN-2013 15:35:11</u>	R	RA	TABACHI	-	1-STATUS change
<u>FRI_28-JUN-2013 15:35:11</u>	2013-06-28 00:00	2013-07-05 00:00	TABACHI	-	15-SCHED.END DATE change
<u>FRI_28-JUN-2013 15:35:45</u>	-	95881	TABACHI	-	19-ASSIGNED TO change
<u>FRI_28-JUN-2013 16:10:16</u>	95881	102889	HIRSESCU	-	19-ASSIGNED TO change
<u>FRI_05-JUL-2013 16:05:56</u>	RA	RADP	BCHOLLAT	-	1-STATUS change
<u>MON_08-JUL-2013 08:37:30</u>	RADP	RA	DPICARD	-	1-STATUS change
<u>MON_29-JUL-2013 16:09:40</u>	102889	95881	BCHOLLAT	-	19-ASSIGNED TO change
<u>TUE_30-JUL-2013 17:35:21</u>	RA	TT	HIRSESCU	-	1-STATUS change
<u>THU_01-AUG-2013 11:41:36</u>	TT	T	FJUBAN	-	1-STATUS change
<u>TUE_13-AUG-2013 16:40:08</u>	T	RTP	*	-	1-STATUS change
<u>TUE_13-AUG-2013 16:40:27</u>	RTP	TP	*	-	1-STATUS change



# Main KPI: Contractor Performance

$$KPI_3 = \frac{\text{Completed PM WOs}}{\text{Total no. of Requested PM WOs}}$$

$$KPI_5 = \frac{\text{Completed PM WOs}}{\text{Total no. of Planned by Contractor PM WOs}}$$

$KPI_7 = \text{Delay in Preventive Maintenance (days)}$

$KPI_{10} = \text{No. of non\_approved WO}$

# Main KPIs: Equipment Condition

*$KPI_{13} = \text{Top 10 positions creating CM}$*

*$KPI = \text{No. of WOs per Cause Code}$*

# Main KPIs : Reactivity

$KPI_{15} = \text{Delay in WOs verification}$

$KPI_{17} = MTTR$

$KPI_{18} = MTTC$

# Main KPIs : Overall performance

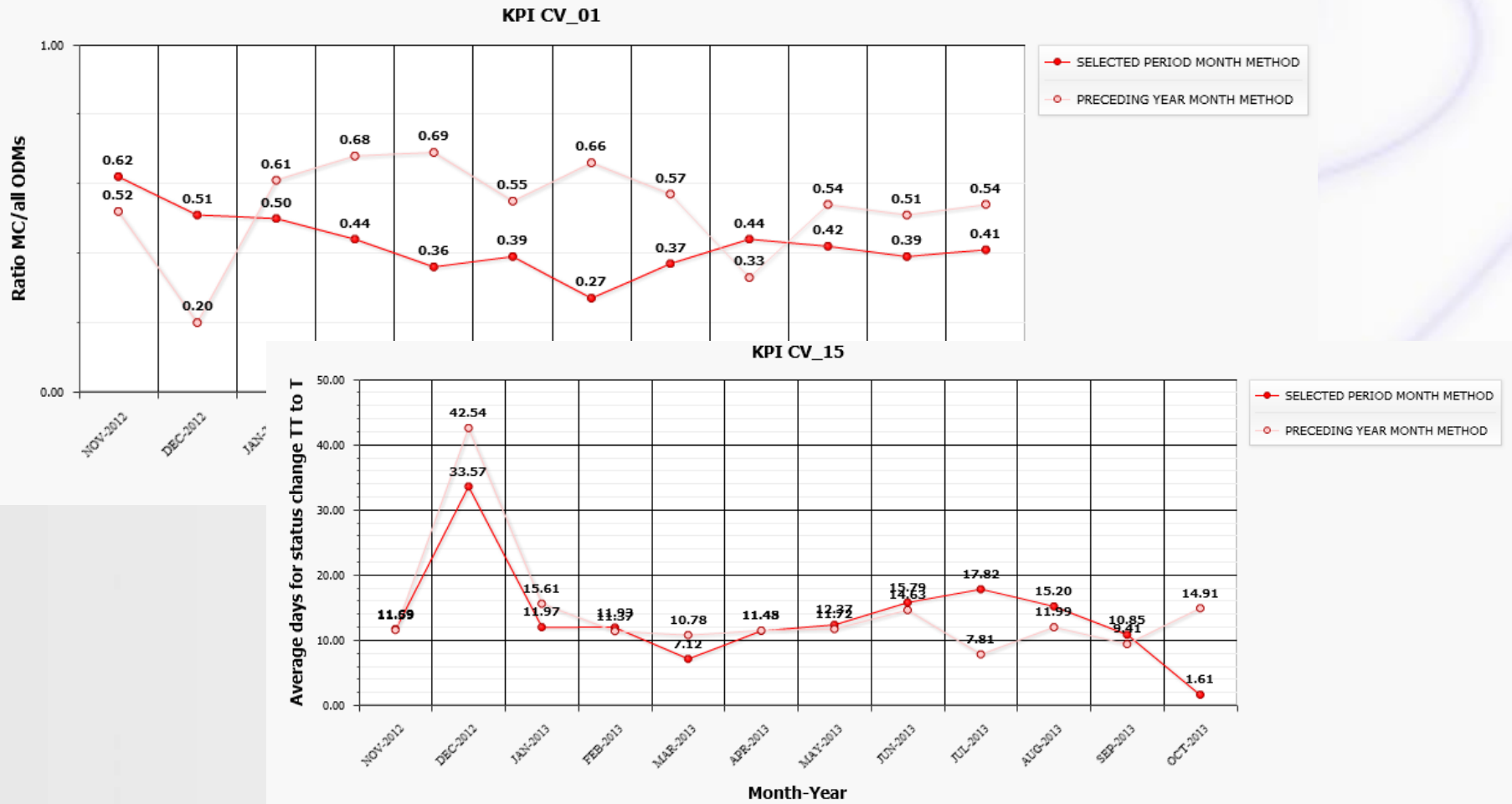
$$KPI_1 = \frac{\text{Completed CM WOs}}{\text{Total no. of Completed WOs}}$$

$$KPI_5 = \frac{\text{Delay in PM (days)}}{\text{Total no. of days between two PM}}$$

$$KPI_7 = \text{No. WOs waiting for access}$$

$$KPI_{11} = \text{No. WOs waiting for spare parts}$$

# Examples of two KPIs over time



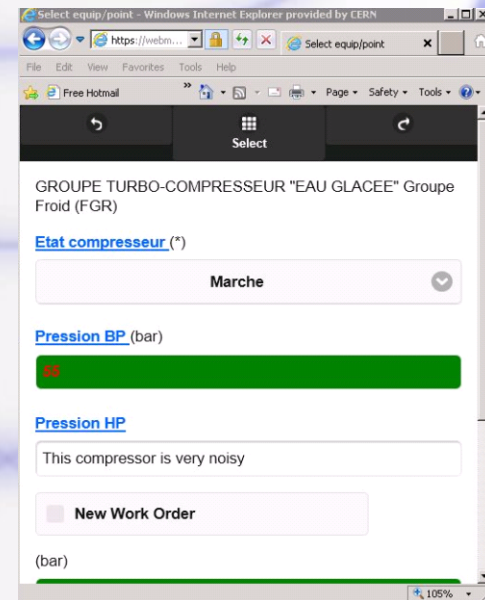
# Meter Readings in the CV group

- Meter readings for different equipment
  - Air Compressors
  - Trane Chillers
- Frequency
  - Different intervals: e.g. weekly, twice per year
  - Configured via Infor EAM PM Schedules
- Visualization
  - Infor EAM Custom Tab: “Inspections & Readings”
- Tools for data entry
  - GS-ASE Infor EAM Mobile (Psion handheld)
  - EN-CV smartphone application

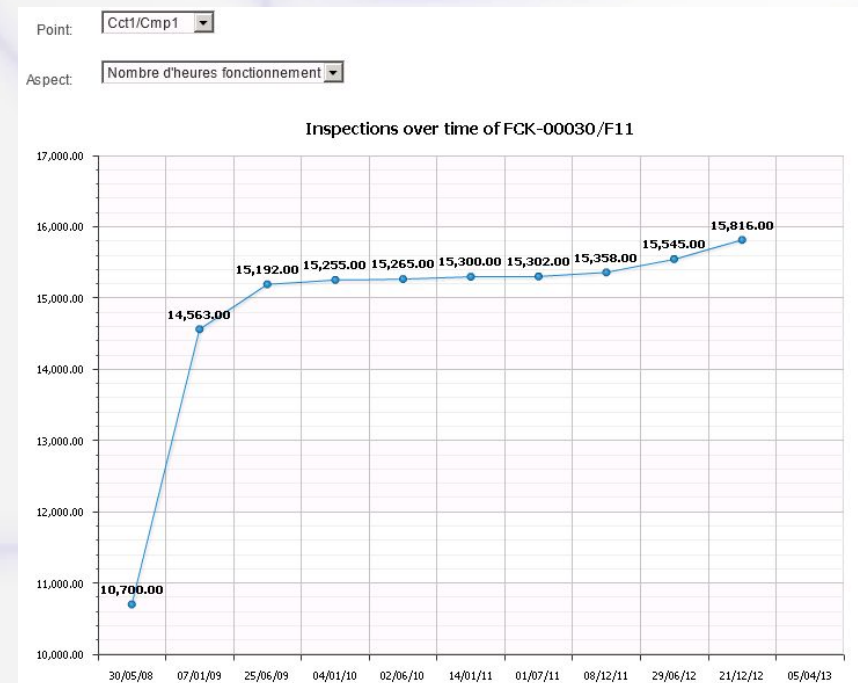
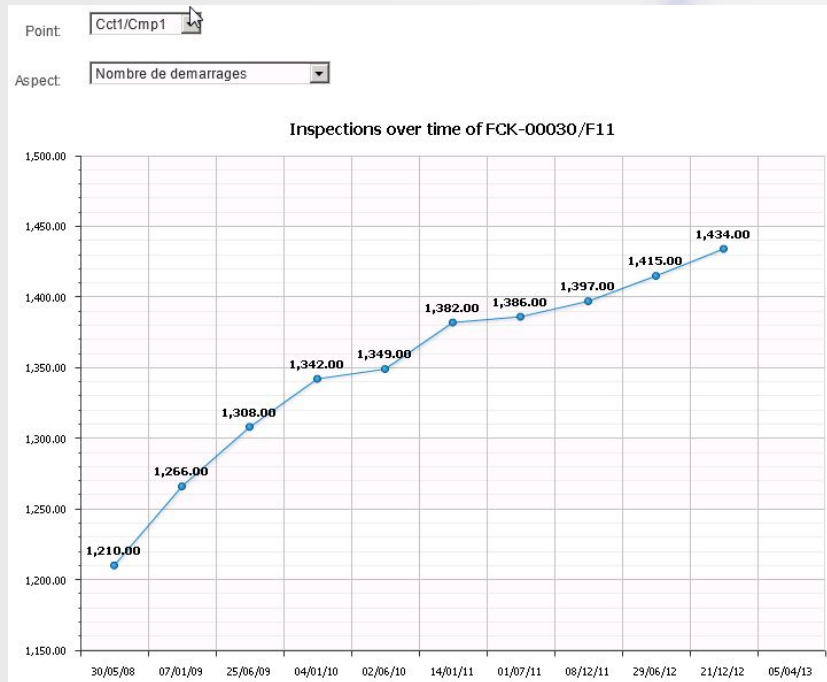


# Meter Readings: CV Smartphone Application

- Webpage application optimised for smartphones
- It organizes the data collection by PM Schedule (can comprise equipment of different Classes)
- No investment required for proprietary equipment and can be on operators personal device (Bring-Your-Own-Device)
- It can also be used from any platform with a Web browser (including Psion Ikon)
- It works off-line in areas without GSM/WiFi
- It is very responsive



# Meter readings: Ex. Historical data of chiller FCK-00030





# Mechanical revision 40000h and cleaning of a chiller in bldg. 355, 378



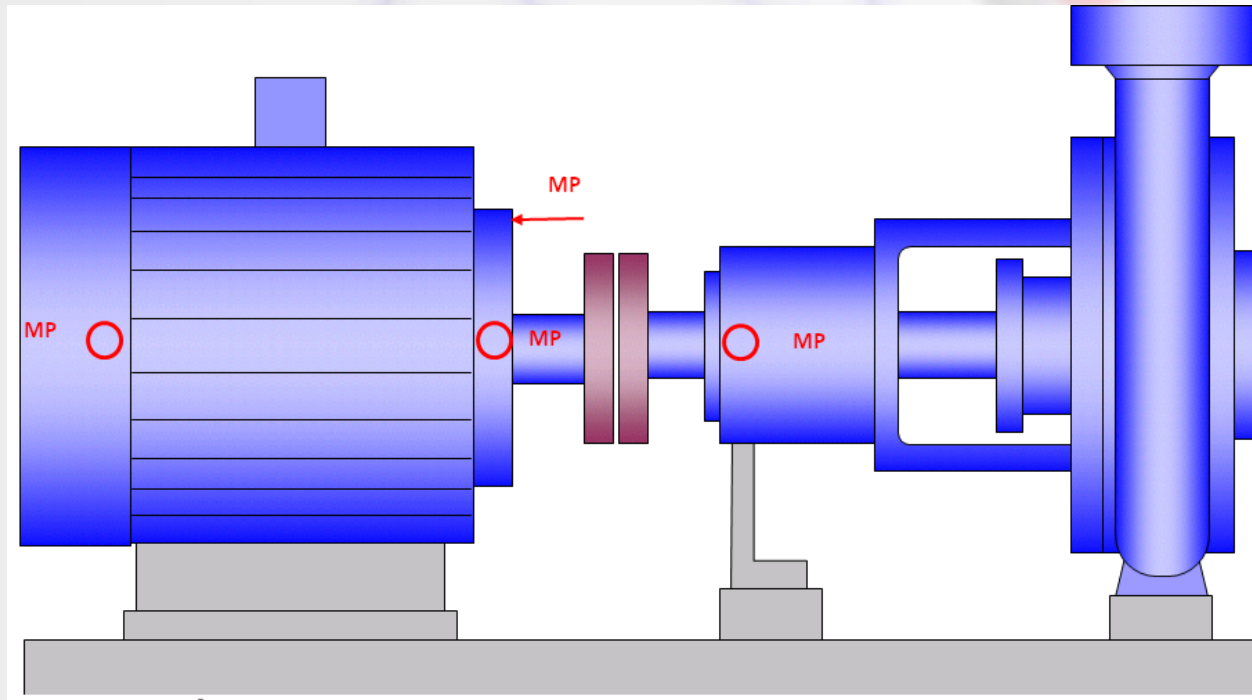
**RAPPORT  
D'ANALYSE DE TUBES  
Par courant de  
Foucault**



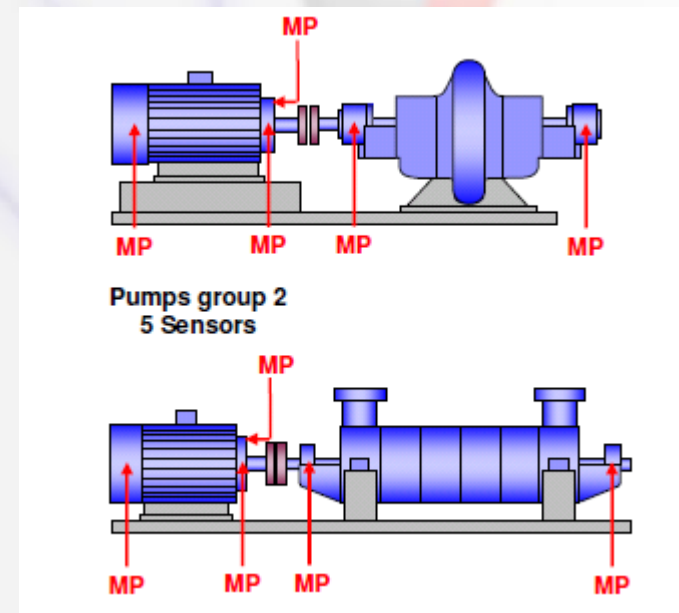
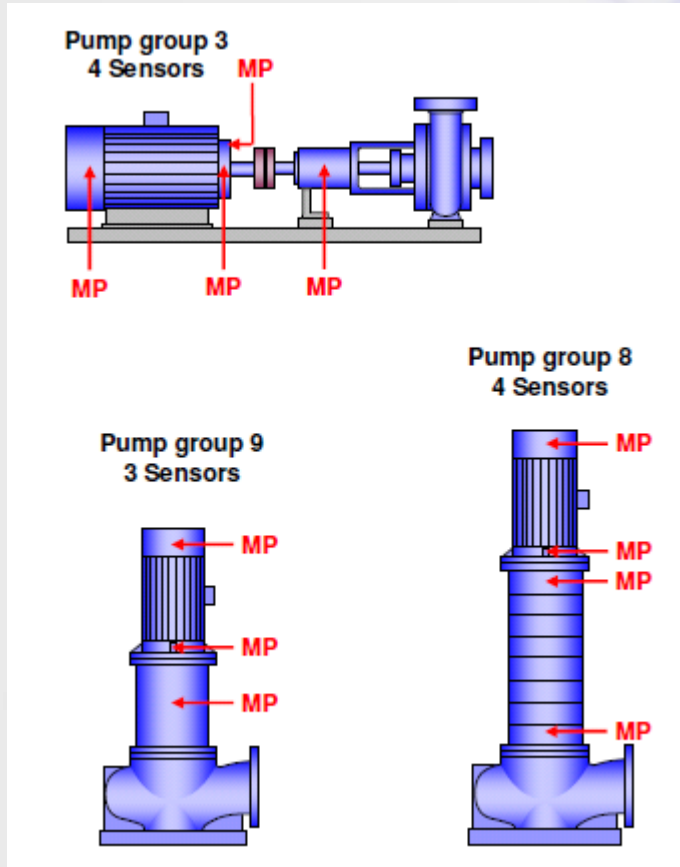
... before and after cleaning  
bldg. 378



# Conditional Maintenance: Vibration analyses

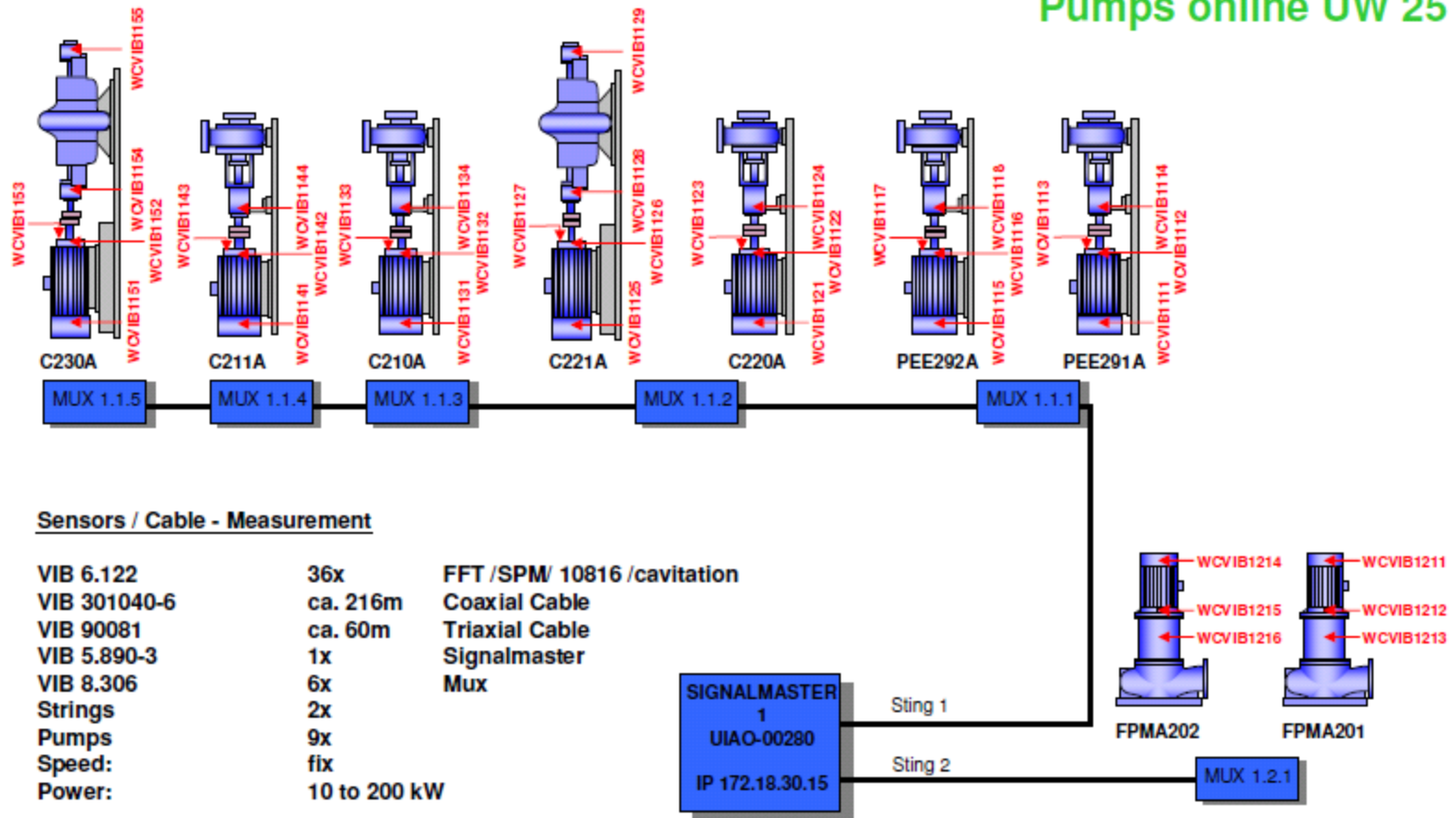


# Conditional Maintenance: Vibration analyses

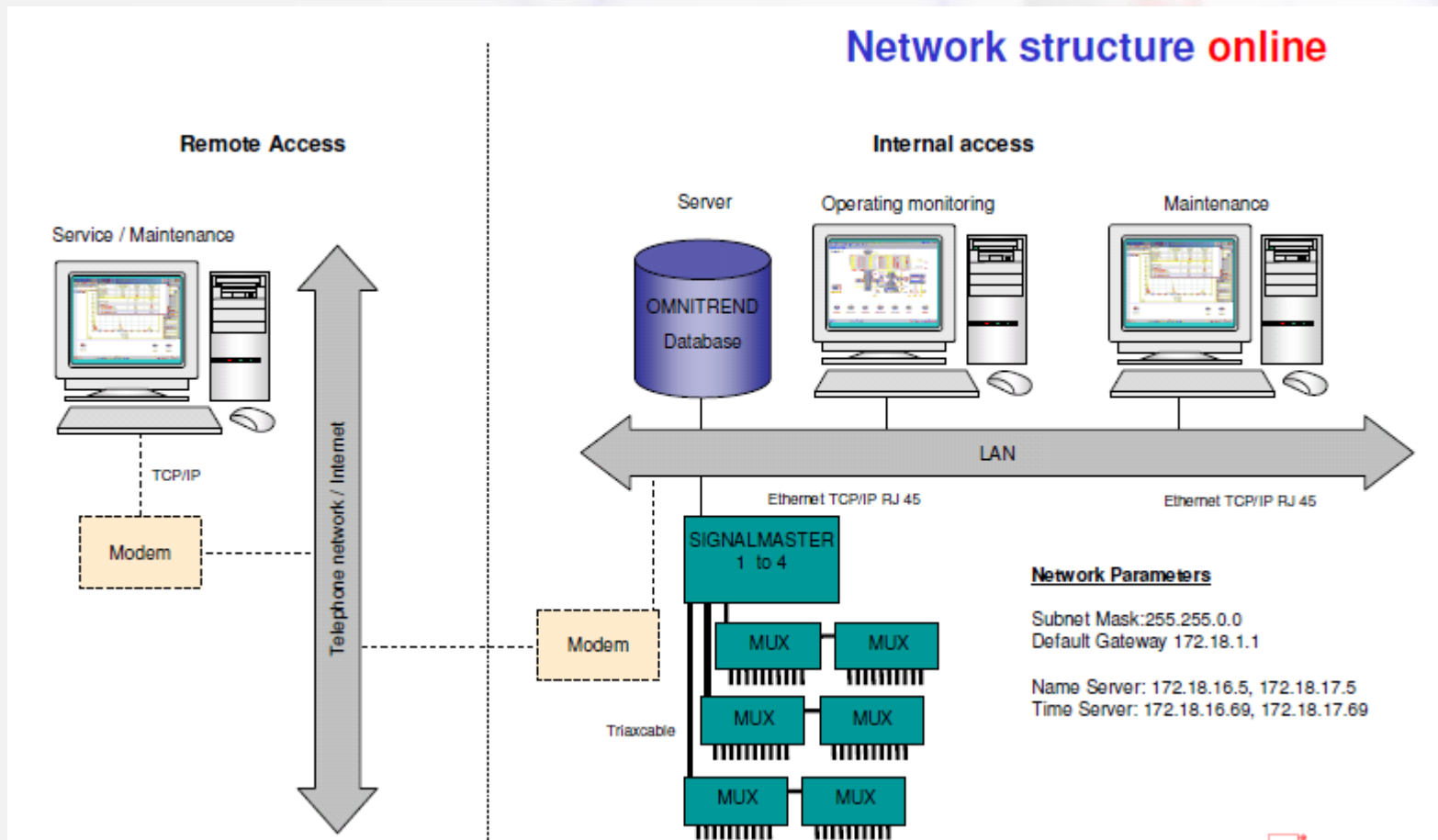


# Conditional Maintenance: Vibration analyses

Pumps online UW 25



# Conditional Maintenance: Vibration analyses

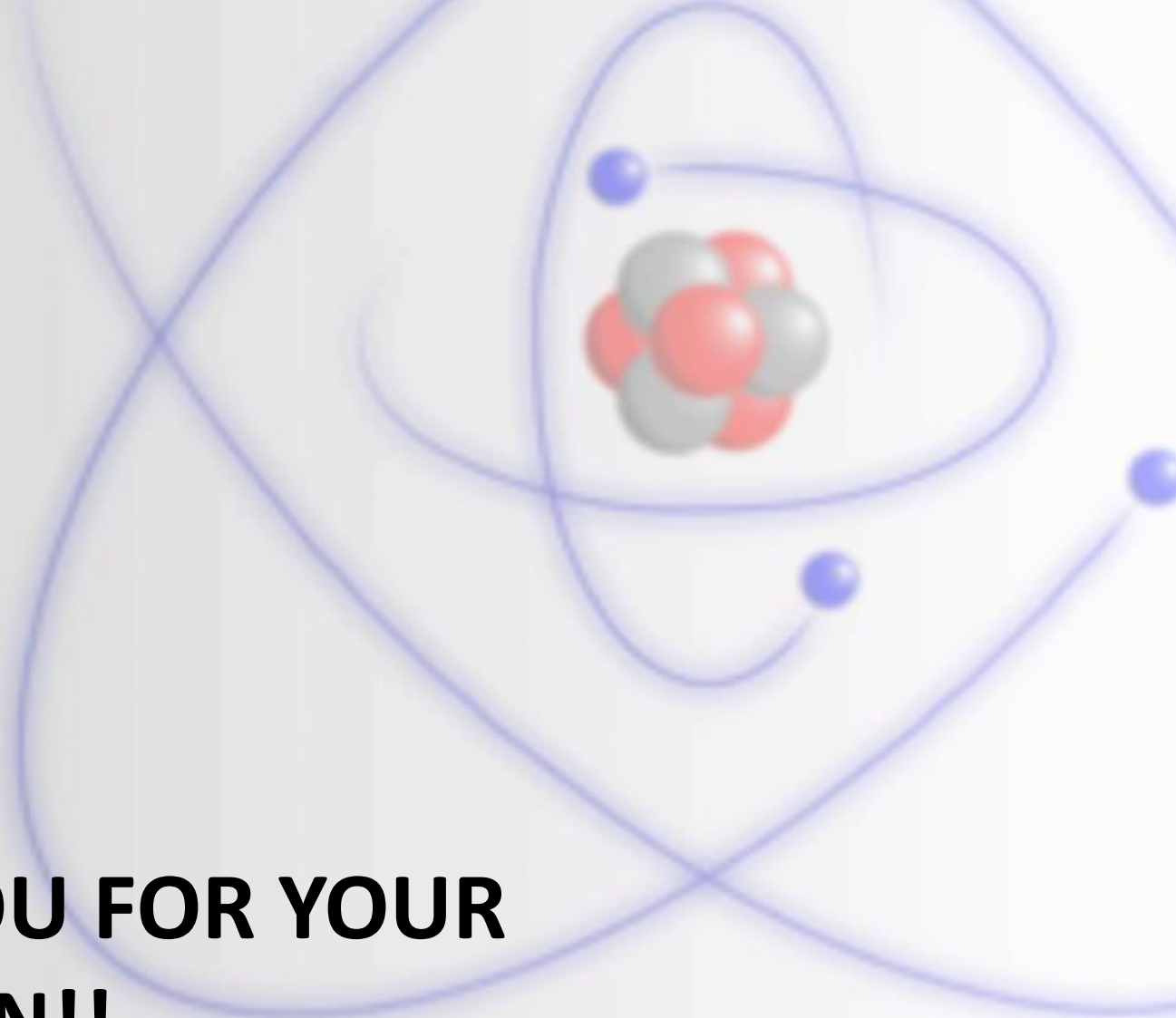


# Summary

- EN/CV utilises the main modules of INFOR EAM
- Information entered by the System, CV staff and Maintenance contractors is crucial to assess the different actors in maintenance
- CV makes use of tailored made *KPI* to pinpoint weak and strong points in the Maintenance activities
- *Particular Meter Readings* are valuable information to trigger conditional maintenance in some equipment such chillers and compressors
- A specific project has been made for *Conditional Maintenance* based on Vibration measurements

# Conclusions

- Structure of equipment → it reduces the intervention time for all the maintenance participants
- KPIs, utilised to better monitor the Maintenance Activity and plants condition to:
  - Support the decisions by the CERN management
  - Take actions by Stores and Operations
  - Manage of Contractors
  - Repair and improve the installations
- Meter readings
  - Faster data entry and interpretation of results
  - Clearer vision of the equipment utilization over time
- Vibration analysis
  - Detect risk and allow for intervention before breakdown



**THANK YOU FOR YOUR  
ATTENTION!!**



