

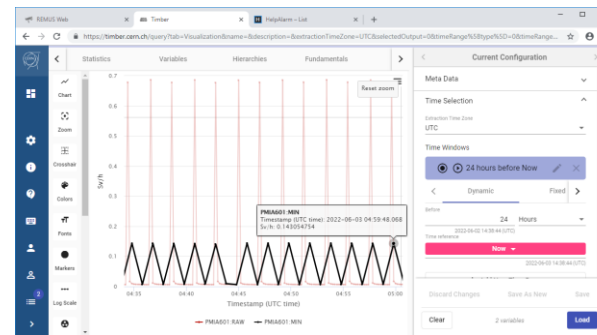
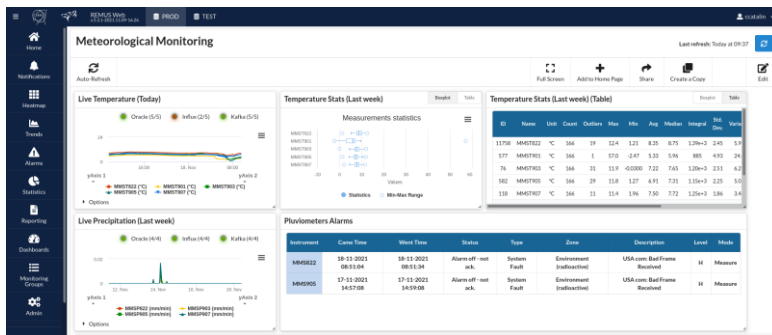


HSE

Occupational Health & Safety
and Environmental Protection unit



HSE Seminar: Exploiting data of the Radiological and Environmental Monitoring System



CERN ALARM CONSOLE - LIST

ID	Time	Status	Building	Site	Safety zone	Fault member	Fault family	Point description	Log name	16:36:54	1/20	1/14
128158	Today 16:24:26	Active	378	MEY	19	FEED-00054	EALU_DEMI_MEY	ALARME PH PROBLEME DES EAUX DE REJET	FWMEYFEED-00054.PH.REJET_PUBLIAN	OPC...		
148719	Today 16:12:31	Active	378	MEY	19	FEED-00054	EALU_DEMI_MEY	ALARME GENERALE REJET BATEAU VERIFICATION NIVEAU DE SECURITE DES EAUX DE REJET	FWMEYFEED-00054.REJET_378	JEC...		
128154	Today 16:12:31	Active	378	MEY	19	FEED-00054	EALU_DEMI_MEY	ALARME PH REJET	FWMEYFEED-00054.PH.REJET_FOODS	OPC...		
128157	Today 16:12:31	Active	378	MEY	19	FEED-00054	EALU_DEMI_MEY	FOISSE DE REINTRACTION	FWMEYFEED-00054.PH.REJET_FOODS	OPC...		
371259	Today 13:47:09	Active	612 (M4E47C)	MEY	19	FSF06-00010	THEM_VERT_MEY	DEFAULT GENERAL UNITE FV050013	SWMEYFSF06-00010.DET_MIN	ICL...		
139639	Today 12:33:25	Active	UNIC55/1 (352)	LIS	19	FOLE-00059	SEILUORCARL...	DEFAULT GENERAL INSTALLATION	ICLISFOLE-00059.SILORCARL...	OPC...		
109937	Today 10:05:44	Active	376 (M650)	M19	19	SFDW-00319	SECIL_FEU_MEY	DEFAULT CENTRALE DE DETECTION INCENDIE	SWM19SFDW-00319.DEFAULT_BAT376	JEC...		
175702	Today 10:00:46	Active	376 (M650A)	M19	19	SFDW-00319	SECIL_FEU_MEY	DEFAULT CENTRALE DE DETECTION INCENDIE	SWM19SFDW-00319.DEFAULT...	OP...		

CERN HSE Unit

A. Lededul, G. De La Cruz, F. Malacrida, M. Widorski, J. Regnard, C. Chiriac, H. Boukabache

Introduction

```
kafkaCLI: bash - Konsole
File Edit View Bookmarks Settings Help
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kafkaCLI: bash
```



How to make sense of this ?

Context

From Instrumentation to Operation

OPERATIONAL RADIATION PROTECTION

CONTAMINATION

GATE

VENTILATION

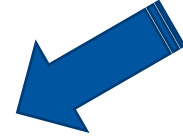
WEATHER

AIR

WATER



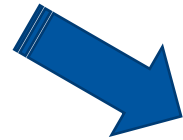
Commands
On, Off, Sample, etc.
Parameters
Thresholds, Units, etc.



300 active users



800 stations



Measurements
Alarm signals
Faults
Process Statuses



Radiation Protection & Environmental Experts



CERN Control Centre



Experiments Control Rooms



Safety Control Room

50k parameters

800 synoptic

120k defined alarms

10M meas./hour

REMUS
Supervision
Control
Data Acquisition

ERGO
Data Visualization

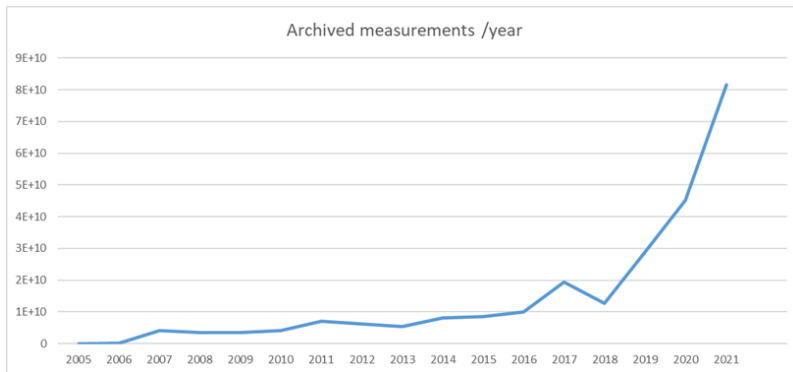
REMS = Radiological and Environmental Monitoring System
REMUS = Radiation and Environment Monitoring Unified Supervision
ERGO = Environment and Radiation Graphic Observer
SCADA = Supervisory Control and Data Acquisition

Problem Statement

From Data to Information

REMUS Data in Numbers

- **1,000,000** online variables
- **50,000** remote parameters
- **90,000,000,000** measurements / year

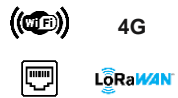


- Alerts to Control Rooms
- Reports to host state authorities
- Data analysis
- Dashboards
- Aggregated statistics
- Predictive maintenance
- Anomaly detection

REMADS Project (2019-2021)

Integrated in HSE RAMSES Program

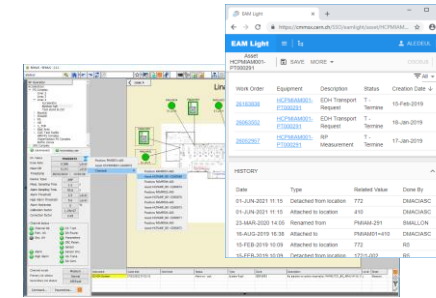
- 6 months discussions with REMS Users
- ↓
- User Requirement Specification
- ↓
- Project Proposition



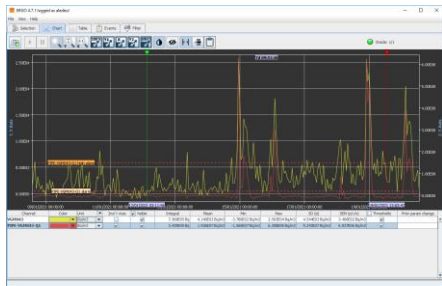
REMUS GPN
Secured GPN
LAN/Wifi/4G/LoRaWAN
connectivity



CERN data-stores
Integration with Kafka
and Hadoop (NXCALs)



InforEAM Integration
Maintenance Management
Information System



ERGO 4.0
Complex transformation
operations on Trends



REMUS Web
Data Analysis toolbox
Portable system for on-site
intervention

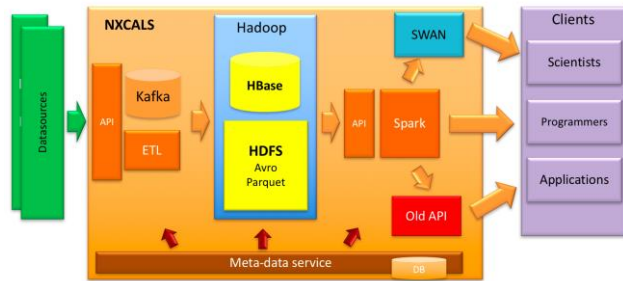
REMADS = REMus Analytics and Data Services
GPN = General Purpose Network
LAN = Local Area Network
LoRaWAN = Long Range Wide Area Network
NXCALS = Next CERN Accelerators Logging Service
EAM = Enterprise Asset Management

Collaboration with other Departments

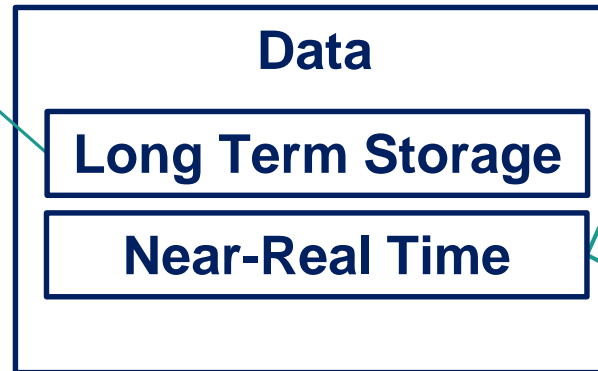
CERN-wide services used

NXCALS

- Big data technologies
- Centralizes CERN accelerator data
- Managed by **BE**



Source: NXCALS - Architecture and Challenges of the Next CERN Accelerator Logging Service, J. Woźniak and Chris Roderick, 2019



- Data Streaming Platform
- Transmit Real-Time data out of REMUS
- Managed by **IT**



- Time Series Database
- Buffer Real Time data
- Managed by **IT**

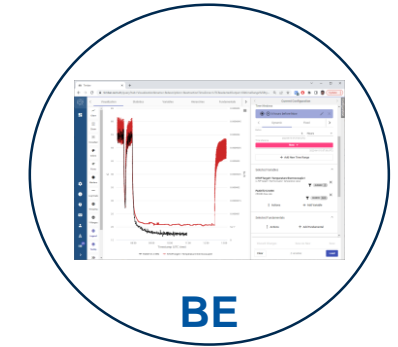
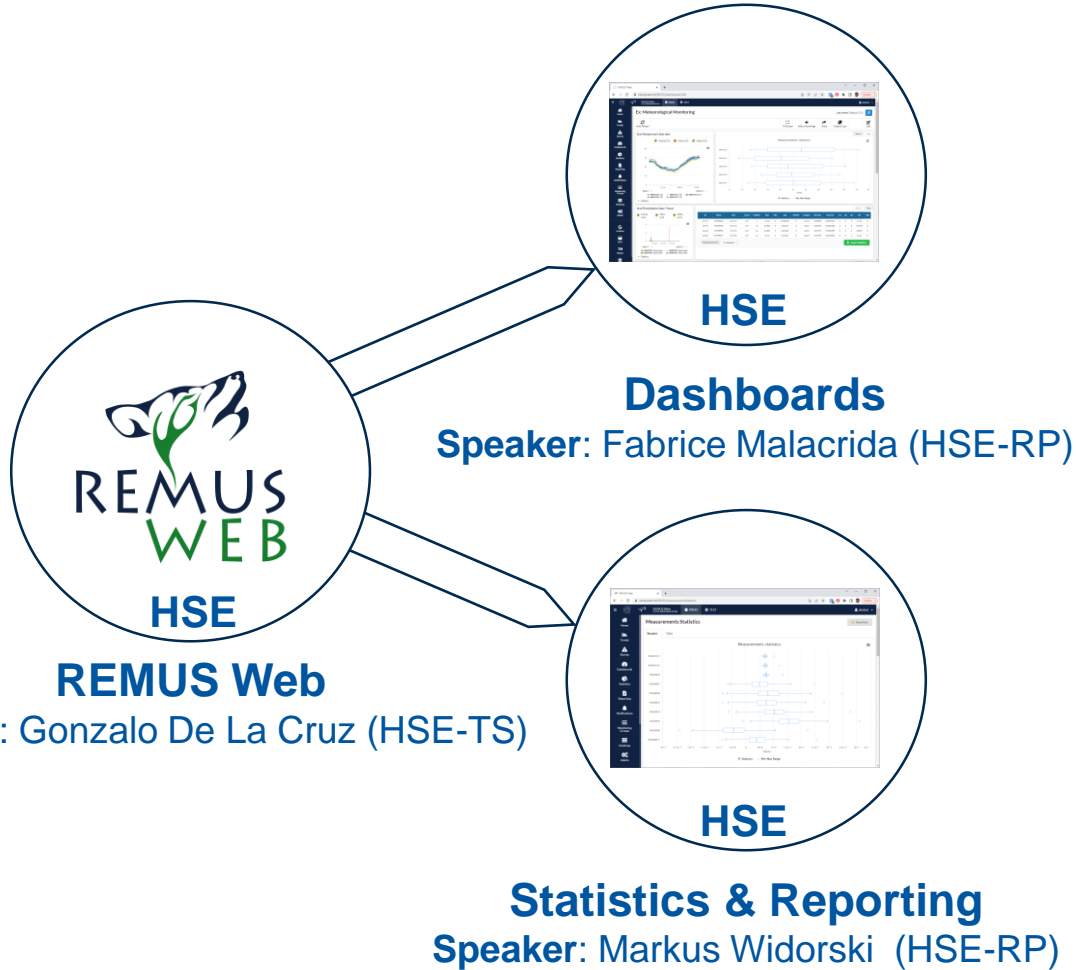
Apache Kafka®:
open-source distributed streaming platform



NXCALS = Next CERN Accelerators Logging Service

Why & How to use the newly available Software Tools ?

Use-cases & Demos



BE

NXCALS & TIMBER

Speaker: Catalina Chiriac (HSE-TS)



EN & BE

InforEAM & HelpAlarm

Speaker: Julien Regnard (HSE-ENV)



IT & BE

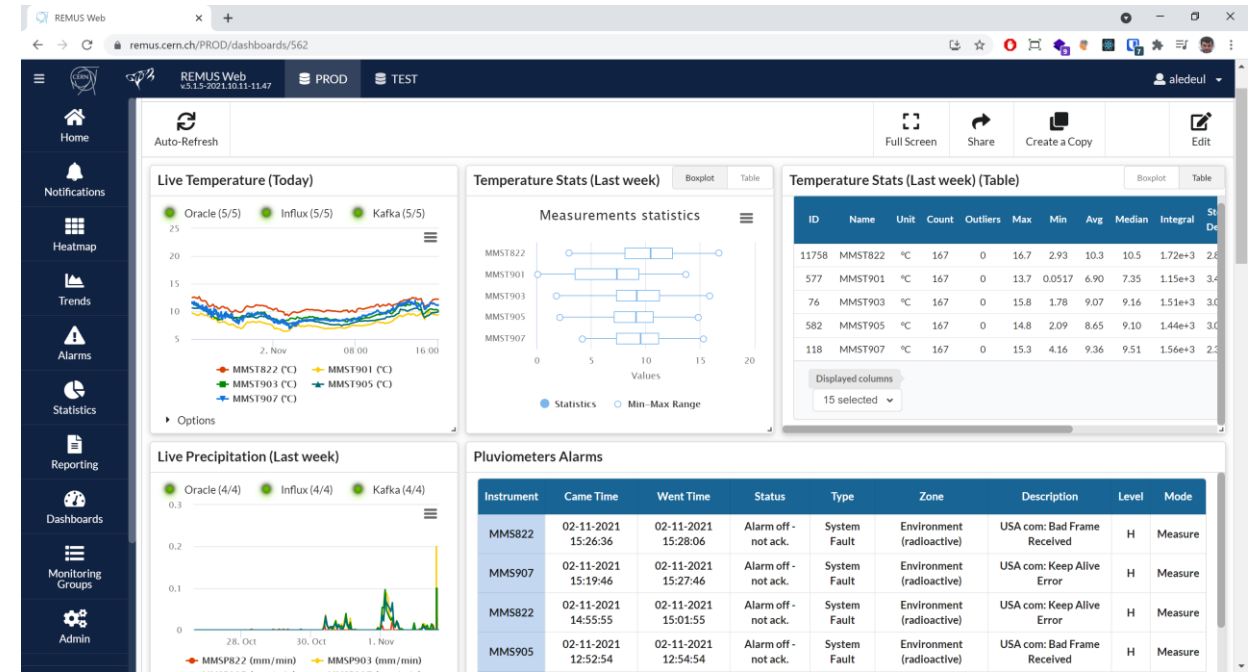
Data Analysis using SWAN

Speaker: Hamza Boukabache (HSE-RP)

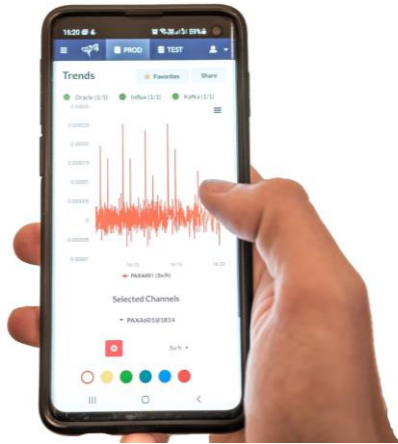
REMUS Web

REMUS Web

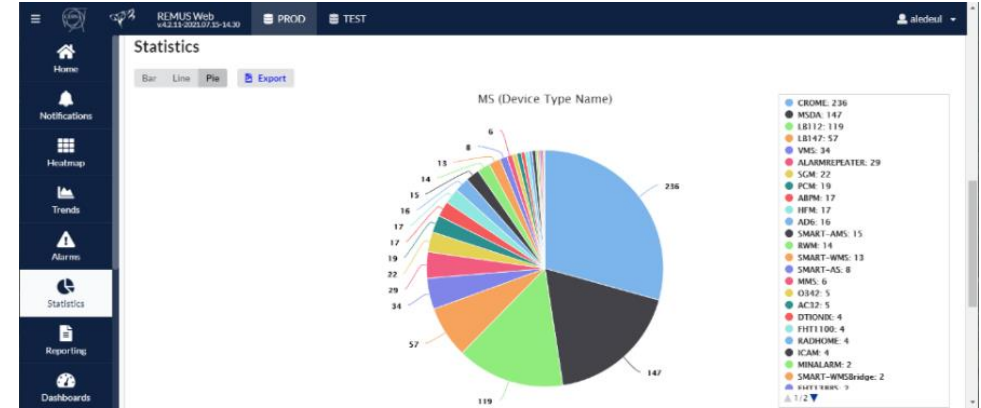
- Dedicated platform for the analysis and exploitation of REMUS data.
- Goals:
 - Facilitate access to REMUS data.
 - Provide data analysis tools for REMUS users.
 - Transform REMUS data into meaningful information.



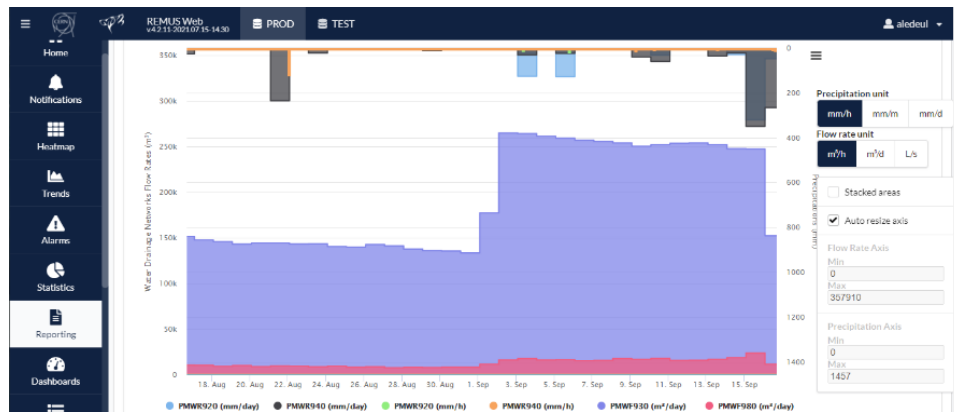
REMUS Web Key Features



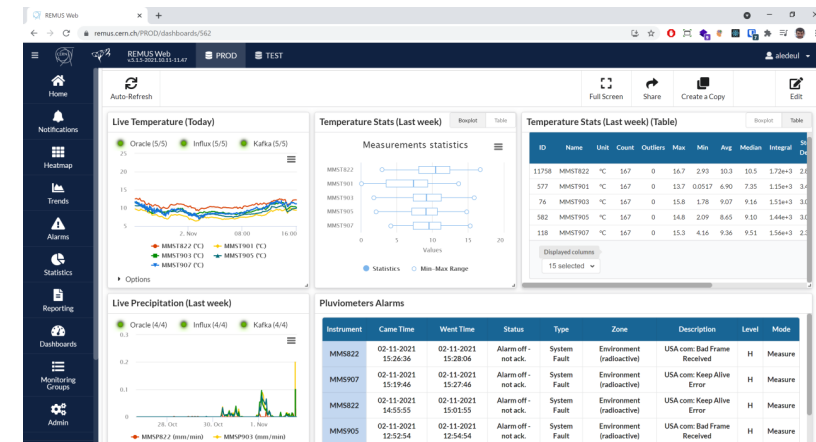
Remote access to REMUS data from any desktop or mobile devices.



Tailor-made data analysis and data extraction tools for Radiation and Environmental protection experts

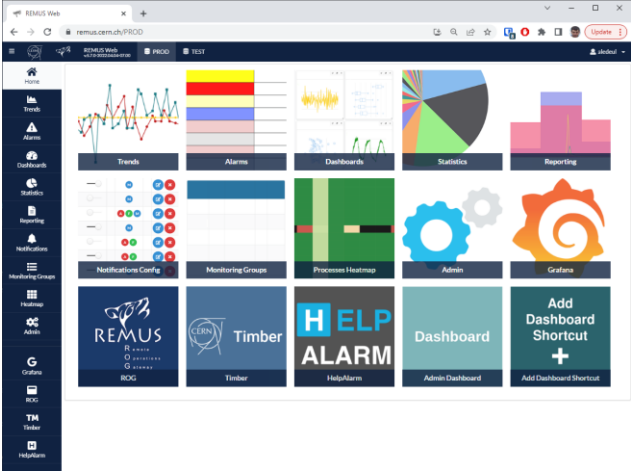


Generation of domain-specific reports for internal analysis and to report to CERN'S host states authorities.



Powerful tool for the creation and visualization of Dashboards.

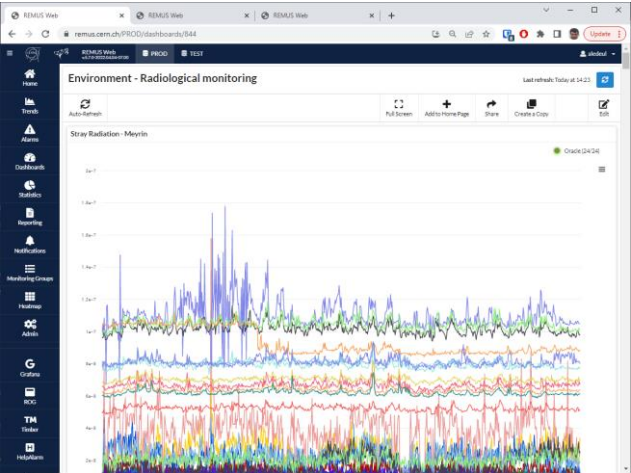
Demo



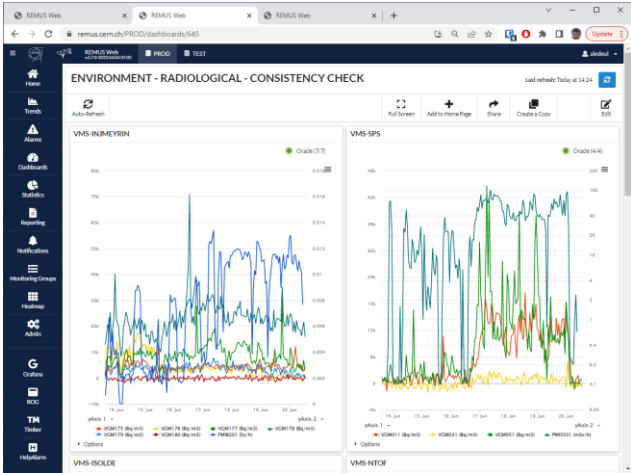
<https://remus.cern.ch>

REMUS Web Dashboards

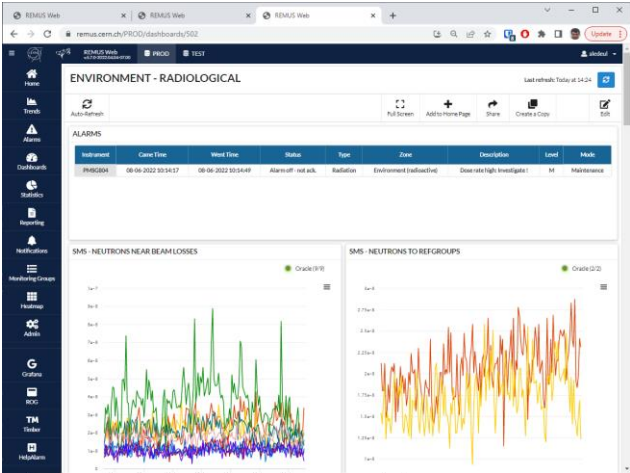
Demo



<https://remus.cern.ch/PROD/dashboards/844>



<https://remus.cern.ch/PROD/dashboards/645>

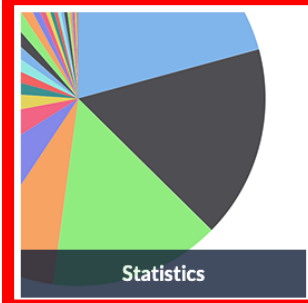


<https://remus.cern.ch/PROD/dashboards/502>

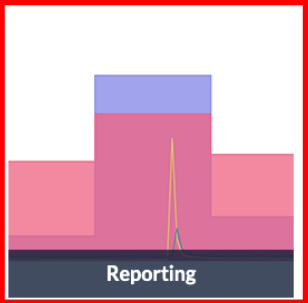
REMUS Web Statistics & Reporting

REMUS Web v5.7.0-2022.04.04-07.00 PROD TEST mrettig

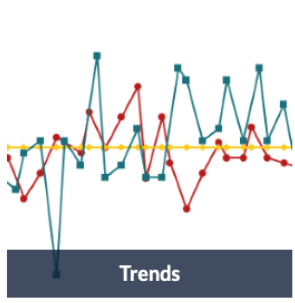
- Home
- Trends
- Alarms
- Dashboards
- Statistics**
- Reporting**
- Notifications
- Monitoring Groups
- Heatmap
- Grafana
- ROG
- TM Timber
- HelpAlarm




Statistics




Reporting



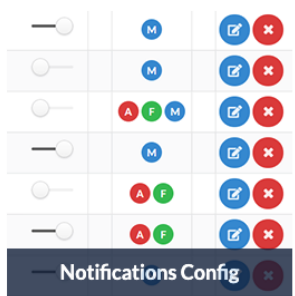
Trends



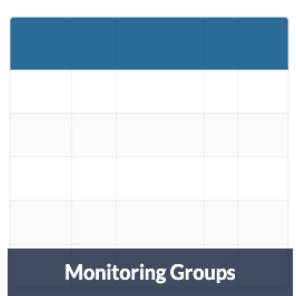
Alarms



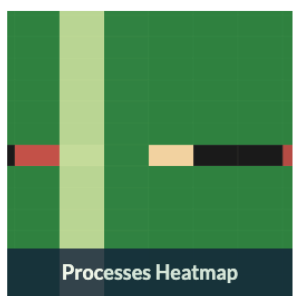
Dashboards




Notifications Config




Monitoring Groups




Processes Heatmap




Grafana




ROG



Timber



HelpAlarm



Add Dashboard Shortcut

REMUS Web v.5.7.0-2022.04.04-07.00

PROD TEST

mrettig

- Home
- Trends
- Alarms
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- Grafana

Channel	MS	Device	Events
Channel History	MS History	Channel Monthly History	MS Monthly History
User Privileges	REMUS Sessions	REMUS Application Sessions	REMUS Synoptics Sessions

Statistics → Channels / Events

- Retrieve monitor/channel names and types in a specific area
- Access the EAM links to a specific measurement position
- Create statistics on specific types of events (alarms, faults): Listing and aggregating

Channel

Q Filters

Channel ID

Channel Name

Device Name

MS Name

Channel Connection Date

Channel Disconnection Date

Ch. Last Modification

Device Type

MS Device Type

Connected TRUE

Usage Domain Name

Zone Name

Device Stock Number

Device Manufacturer

Monitoring Groups PS-ISOLDE

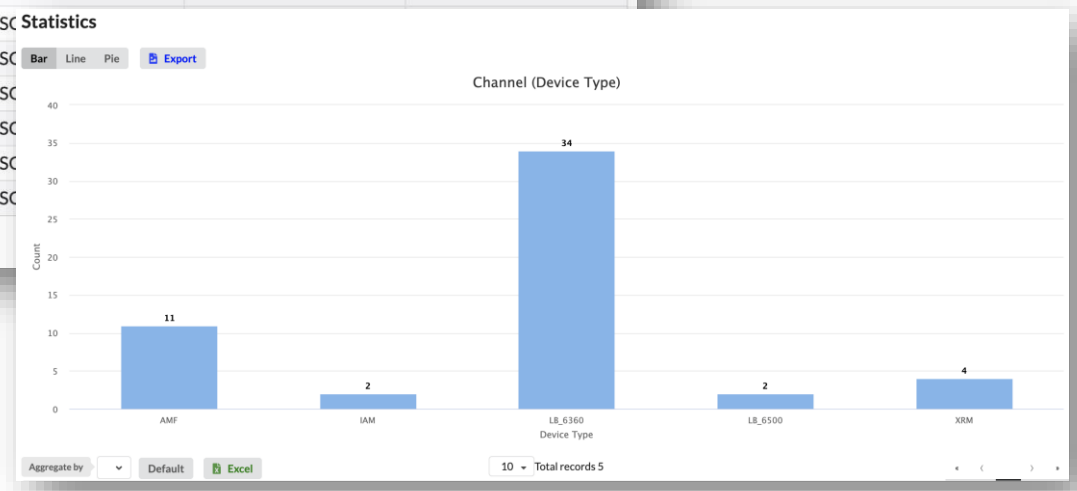
Connected is one of TRUE

AND Monitoring Groups is one of PS-ISOLDE

Filters 15 selected Default Clean filters

Channel Name	MS Name	Ch. Last Modification	Zone Name	Device Stock Numb...	Monitoring Groups	EAM Position	EAM Asset
PAXIS201	PIMSR01=179	02/02/2017	ISOLDE		PS-ISOLDE, ISOLDE-PA, ...	PAMFR01=179	HCPAMF_001-CE000112
PATIS202	PIMSR01=179	02/02/2017	ISOLDE		PS-ISOLDE, ISOLDE-PA, ...	PAMFR01=838	HCPAMF_001-CE000113
PMHIS201	PIMSR02=179	21/12/2016	ISOLDE		PS-ISOLDE	PMBLM07=838	
PMHIS202	PIMSR02=179	21/12/2016	ISOLDE		PS-ISOLDE	PMBLM08=838	
PAXIS301	PIMSR01=197	07/02/2020	ISOLDE		PS-ISC		
PAXIS302	PIMSR01=197	07/02/2020	ISOLDE		PS-ISC		
PAXIS303	PIMSR01=197	07/02/2020	ISOLDE		PS-ISC		
PAXIS304	PIMSR01=197	07/02/2020	ISOLDE		PS-ISC		
PAXIS203	PIMSR01=179	02/02/2017	ISOLDE		PS-ISC		
PAGIS101	PIMLB02=179	27/05/2014	ISOLDE	1045	PS-ISC		

Display columns 8 selected Default Excel 10 Total records 53



Q Filters

Event type Source type 2 selected Timestamp 01-06 To Message

Username Source name PAM Transition TRUE Event Work Mode

Monitoring Groups Source ID

Source type is one of Channel, MS

AND Source name is PAM

AND Timestamp from We, 01/06/2022 00:00:00

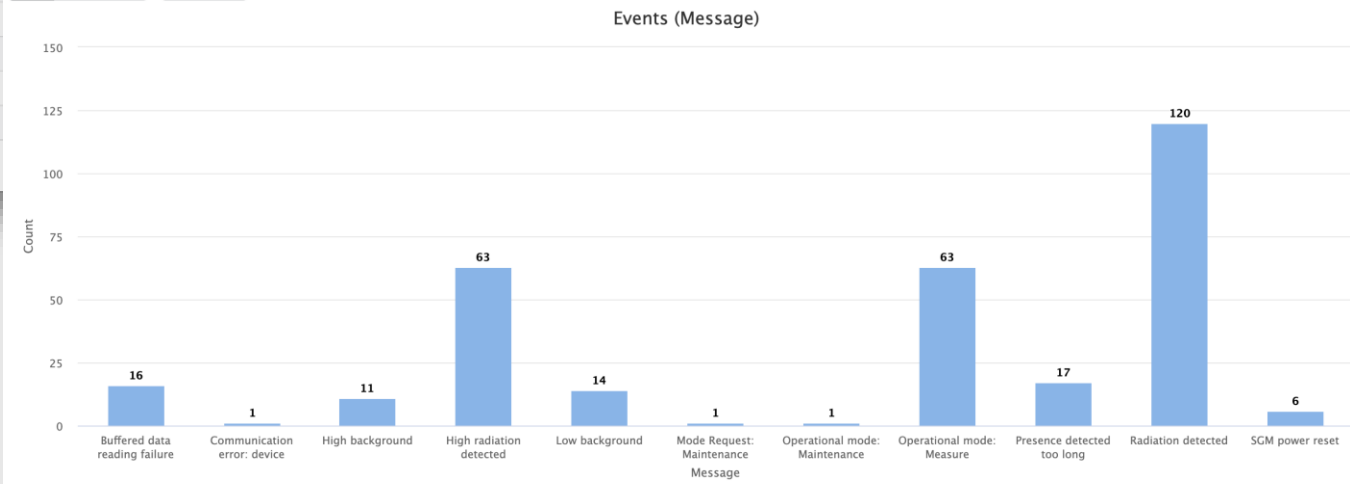
AND Transition is one of TRUE

Event type	Username	Monitoring Groups	Source type	Source name	Source ID	Timestamp	Transition	Message	Event Work ...
System Fault	cs-ccr-rems10		MS	PAMA01	151	Th, 09/06/2022 08:...	TRUE	Communication err...	Measure
System Fault	remus_sgm		MS	PAML101	167	We, 01/06/2022 0...	TRUE	SGM power reset	Measure
System Fault	remus_sgm		MS	PAML101	167	We, 01/06/2022 1...	TRUE	SGM power reset	Measure
System Fault	cs-ccr-rems10		MS	PAML101	167	Th, 02/06/2022 11:...	TRUE	Buffered data readi...	Measure
System Fault	cs-ccr-rems10		MS	PAML101	167				
System Fault	cs-ccr-rems10		MS	PAML101	167				
System Fault	cs-ccr-rems10		MS	PAML101	167				
System Fault	cs-ccr-rems10		MS	PAML101	167				
System Fault	remus_sgm		MS	PAML101	167				
System Fault	cs-ccr-rems10		MS	PAML101	167				

Display columns 10 selected Default Excel 10 Total records 313

Statistics

Bar Line Pie Export



Aggregate by Default Excel 100 Total records 11

REMUS Web v.5.7.0-2022.04.04-07.00

PROD TEST

mrettig

- Home
- Trends
- Alarms
- Dashboards
- Statistics
- Reporting
- Notifications
- Monitoring Groups
- Heatmap
- Grafana
- DOC

Measurements Statistics

Alarm Extraction

Availability

Parameters Report

Snapshots Report

Meteo Data Extraction

Hyetogram

Reporting → Measurement / Parameter / Snapshot

- Get summary statistics of measurements on a group of channels for extended periods
- Check parameters settings of a groups of channels for quick validation or comparison
- Reporting specific for control measurements (HFM, Portal monitors) to generate statistics on number and results of controls

Measurement reporting

Period:

Last: MINUTE HOUR **DAY** WEEK MONTH

Data resolution: Auto Hour **Minute** Best

Data Source: Oracle **NXCALS**

Working modes:

 Off

 Measure

 Test

 Simulation

 Maintenance

 Calibration

 Without Mode

 Silent

 Degraded

Alarm Filters: NO ALARM

Fault Filters: FAULT

ID	Name	Unit	Count	Outliers	Max	Min	Avg	Median	Integral	Std. Dev.	Variance	Q1	Q2	Q3	Q4	IQR
13939	PAXSM101	µSv/h	10078	95000000	0.102	0.0605	0.0687	0.0687	693	0.00267	7.11e-12	0.0669	0.0687	0.0705	0.102	0.00352
13948	PAXSM102	µSv/h	10078	91000000	0.121	0.0609	0.0700	0.0699	706	0.00280	7.81e-12	0.0682	0.0699	0.0718	0.121	0.00364
13957	PAXSMKA	µSv/h	10078	103000000	0.132	0.0626	0.0724	0.0723	729	0.00285	8.12e-12	0.0705	0.0723	0.0741	0.132	0.00363
13849	PAXSMM7	µSv/h	10078	107000000	0.248	-0.0652	0.0522	0.0492	526	0.0417	1.74e-9	0.0223	0.0492	0.0788	0.248	0.0565
13876	PAXSMM9	µSv/h	10078	77000000	0.348	-0.0921	0.0876	0.0849	882	0.0571	3.27e-9	0.0483	0.0849	0.125	0.348	0.0765
13903	PAXSMV3	µSv/h	10077	62000000	0.286	-0.0853	0.0753	0.0740	759	0.0519	2.70e-9	0.0393	0.0740	0.110	0.286	0.0706
13867	PAXSMV4	µSv/h	10079	79000000	0.377	-0.0630	0.104	0.104	1.05e+3	0.0527	2.77e-9	0.0680	0.104	0.139	0.377	0.0708
13912	PAXSMV5	µSv/h	10079	78000000	0.410	-0.0237	0.158	0.158	1.59e+3	0.0551	3.04e-9	0.122	0.158	0.194	0.410	0.0727
13921	PAXSMV6	µSv/h	10078	80000000	0.223	-0.240	-0.0408	-0.0409	-411	0.0591	3.50e-9	-0.0799	-0.0409	-0.00164	0.223	0.0782
13858	PMISM71	µSv/h	10079	105000000	0.256	-0.0830	0.0431	0.0399	435	0.0435	1.90e-9	0.0127	0.0399	0.0704	0.256	0.0577
13894	PMISM91	µSv/h	10079	104000000	0.338	-0.0701	0.102	0.0981	1.03e+3	0.0552	3.05e-9	0.0633	0.0981	0.137	0.338	0.0741

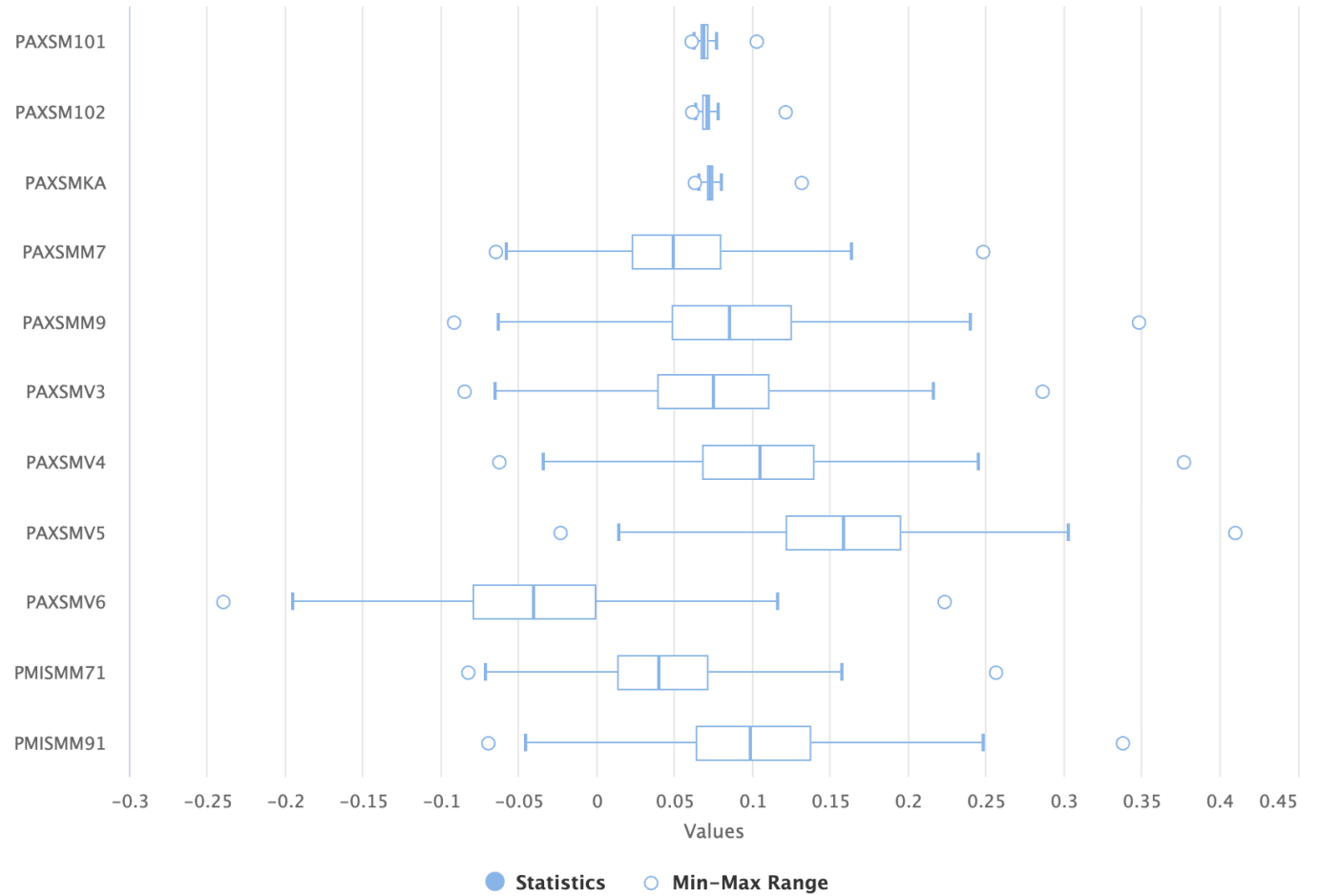
Displayed columns: 15 selected

[Export Statistics](#)

Boxplot

Table

Measurements statistics



Parameter reporting

MS ID: MS Name: Zone: Usage:

MS ID	MS Name	Device type	Zone	Usage	Timestamp	ALARM THRESHOLD	ALERT THRESHOLD	AVG TIME FACTOR	MEAS TIME	SPECIAL ALARM THRESHOLD
1627	PATNA8101	CROME	SPS EHN1	Radiation	14-03-2022 08:58:18	0.000100	0.0000500	100	12	0
1628	PATNA8201	CROME	SPS EHN1	Radiation	14-03-2022 08:57:14	0.000100	0.0000500	100	12	0
1647	PATNA852	CROME	SPS EHN2	Radiation	07-02-2022 15:41:39	0	0	100	12	0
1565	PAXNA11201	CROME	SPS EHN1	Radiation	14-03-2022 08:54:14	0.00000600	0.00000300	100	12	0
1605	PAXNA12401	CROME	SPS EHN1	Radiation	14-03-2022 08:55:05	0.0000300	0.0000150	100	12	0
1592	PAXNA12402	CROME	SPS EHN1	Radiation	17-03-2022 14:48:16	0.0000300	0.0000150	100	12	0
1626	PAXNA12601	CROME	SPS EHN1	Radiation	08-06-2022 08:26:41	0.000100	0.0000500	100	12	0
1606	PAXNA12612	CROME	SPS EHN1	Radiation	16-06-2022 11:00:39	0.0000500	0.0000300	100	12	0
1607	PAXNA12801	CROME	SPS EHN1	Radiation	14-03-2022 08:57:35	0.0000300	0.0000150	100	12	0
1608	PAXNA13201	CROME	SPS EHN1	Radiation	14-03-2022 08:58:10	0.0000300	0.0000150	100	12	0
1593	PAXNA13202	CROME	SPS EHN1	Radiation	14-03-2022 08:58:36	0.00000600	0.00000300	100	12	0
1594	PAXNA13203	CROME	SPS EHN1	Radiation	14-03-2022 08:58:58	0.0000300	0.0000150	100	12	0
1609	PAXNA13401	CROME	SPS EHN1	Radiation	17-03-2022 14:26:00	0.0000300	0.0000150	100	12	0
1595	PAXNA13402	CROME	SPS EHN1	Radiation	17-03-2022 14:36:16	0.0000300	0.0000150	100	12	0
1610	PAXNA13601	CROME	SPS EHN1	Radiation	17-03-2022 14:56:02	0.0000300	0.0000150	100	12	0
1611	PAXNA13801	CROME	SPS EHN1	Radiation	14-03-2022 09:00:35	0.0000300	0.0000150	100	12	0
1612	PAXNA14201	CROME	SPS EHN1	Radiation	14-03-2022 08:01:01	0.0000300	0.0000150	100	12	0

Snapshot reporting

Select Snapshot Type Select MS

Filters

SOURCE NAME

Advanced search Reset filters

SOURCES CATALOG

SOURCE TYPE	NAME	ZONE	TYPE	USAGE
MS	METRUM	Portal monitors	FHT13885	Radiation
MS	PRETRUM	Portal monitors	FHT13885	Radiation

SOURCE NAME

SOURCE TYPE	NAME	ZONE	TYPE	USAGE
MS	METRUM	Portal monitors	FHT13885	Radiation
MS	PRETRUM	Portal monitors	FHT13885	Radiation

Date Selection

Period Date

Last: 1 MINUTE HOUR DAY WEEK **MONTH**

Filters

Alarm status in any channel

Filters Select...

PDF Export	CHANNEL_ID	TIMESTAMP	MS_ID	MS_NAME	PROTOCOL	CERN_ID	DRIVER_NAME	PLATE	SPEED	Det. 1: Gamma - Gross	Det. 1: Gamma - BG	Det. 1: Gamma - Net	Det. 1: Gamma
	12873	16-06-2022 12:50:19	1329	PRETRUM	42	746476			0	1403	1353	50	No Alarm
	12873	16-06-2022 12:34:29	1329	PRETRUM	41	746476			0	1407	1353	54	No Alarm
	12872	16-06-2022 09:17:29	1328	METRUM	47	746476			7	907	875	32	No Alarm
	12872	16-06-2022 07:43:35	1328	METRUM	46	676198			3	907	883	24	No Alarm
	12872	16-06-2022 06:41:57	1328	METRUM	45	676198			0	888	882	6	No Alarm
	12873	15-06-2022 14:12:22	1329	PRETRUM	40	676198			0	1502	1407	95	No Alarm
	12873	15-06-2022 13:52:46	1329	PRETRUM	39	746476			0	1478	1420	58	No Alarm
	12873	15-06-2022 13:14:31	1329	PRETRUM	38	0			0	1513	1433	80	No Alarm
	12873	15-06-2022 11:46:23	1329	PRETRUM	37	676198			0	1547	1471	76	No Alarm
	12873	15-06-2022 11:06:19	1329	PRETRUM	36	846343			4	1419	1462	-43	No Alarm



METRUM Measurement Report HSE-RP

Protocol #45

Measurement date: 16/06/2022 06:41:57

Plate:
Driver:
Unit: SCE-SSC-CS
Company: TRANVOIRIE SA

Speed: 0km/h
Alarm: NO
Artificial radiation alarm: NO
Correlation alarms: NO



Supplier of material:

Remark:

Printed at: 16/06/2022 15:19:30

Signature:

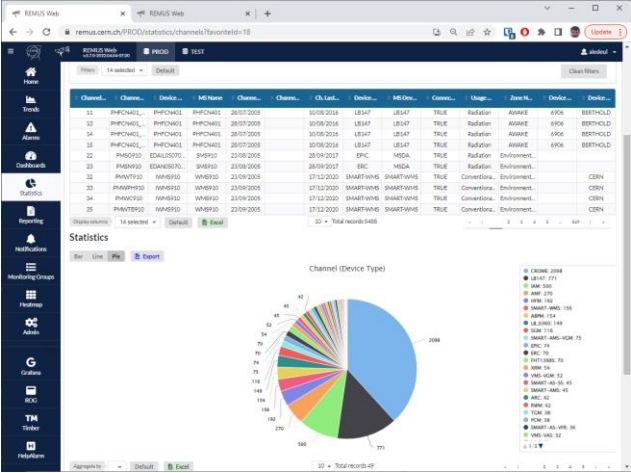


METRUM Measurement Report HSE-RP

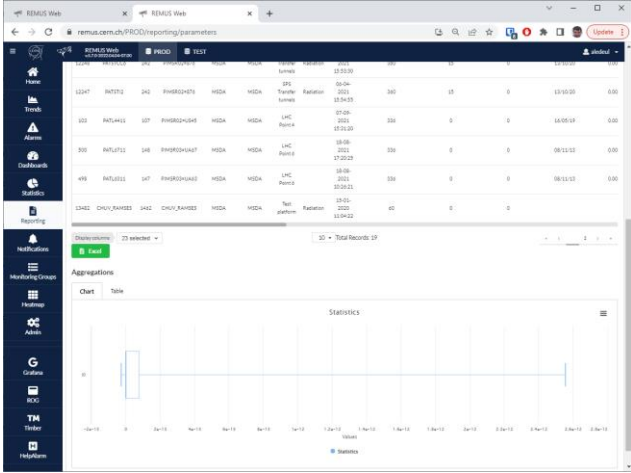
No.	Channel ID	Descriptor	Total Value	Background	Net value	Alarm Threshold	Alarm
1	12804	Det. 1: Gamma	888	882	6	136	NO ALARM
2	12805	Det. 2: Gamma	998	998	0	144	NO ALARM
3	12806	Det. 3: Gamma	813	817	-4	130	NO ALARM
4	12807	Det. 4: Gamma	877	913	-36	138	NO ALARM
5	12808	Det. 5: Gamma	778	805	-27	130	NO ALARM
6	12809	Det. 6: Gamma	873	884	-11	136	NO ALARM
7	12810	Det. 7: Gamma	841	815	26	130	NO ALARM
8	12811	Det. 8: Gamma	899	890	9	135	NO ALARM
9	12812	Det. 9: Gamma	743	796	-53	129	NO ALARM
10	12813	Det. 10: Gamma	885	879	6	135	NO ALARM
11	12814	Det. 11: Gamma	830	840	-10	132	NO ALARM
12	12815	Det. 12: Gamma	834	878	-44	135	NO ALARM
13	12816	Det. 1 & 3: Gamma	1547	1551	-4	177	NO ALARM
14	12817	Det. 2 & 4: Gamma	1863	1898	-35	199	NO ALARM
15	12818	Det. 5 & 7: Gamma	1992	1607	385	183	NO ALARM
16	12819	Det. 6 & 8: Gamma	1758	1752	6	191	NO ALARM
17	12820	Det. 9 & 11: Gamma	1489	1556	-66	178	NO ALARM
18	12821	Det. 10 & 12: Gamma	1713	1743	-30	191	NO ALARM
19	12822	Det. 1 & 3: X	885	868	17	219	NO ALARM
20	12823	Det. 2 & 4: X	1094	1082	12	235	NO ALARM
21	12824	Det. 5 & 7: X	920	905	15	215	NO ALARM
22	12825	Det. 6 & 8: X	1073	1024	49	230	NO ALARM
23	12826	Det. 9 & 11: X	963	922	41	217	NO ALARM
24	12827	Det. 10 & 12: X	1092	1041	51	229	NO ALARM
25	12828	Det. 1 & 3: NBR Co	5.59	5.57	1	1.08	NO ALARM
26	12829	Det. 2 & 4: NBR Co	5.61	5.56	1.01	1.08	NO ALARM
27	12830	Det. 5 & 7: NBR Co	5.57	5.58	1	1.08	NO ALARM
28	12831	Det. 6 & 8: NBR Co	5.61	5.57	1.01	1.08	NO ALARM
29	12832	Det. 9 & 11: NBR Co	5.59	5.57	1	1.08	NO ALARM
30	12833	Det. 10 & 12: NBR Co	5.63	5.58	1.01	1.08	NO ALARM
31	12834	Det. 1 & 3: NBR Co	3.57	3.55	1.01	1.08	NO ALARM
32	12835	Det. 2 & 4: NBR Co	3.54	3.54	1	1.08	NO ALARM
33	12836	Det. 5 & 7: NBR Co	3.5	3.57	0.98	1.08	NO ALARM
34	12837	Det. 6 & 8: NBR Co	3.62	3.57	1.01	1.08	NO ALARM
35	12838	Det. 9 & 11: NBR Co	3.5	3.56	0.98	1.08	NO ALARM
36	12839	Det. 10 & 12: NBR Co	3.51	3.57	0.98	1.08	NO ALARM
37	12840	Sum (left)	4758	4890	-132	319	NO ALARM
38	12841	Sum (right)	5292	5366	-74	334	NO ALARM
39	12842	All NBR Co	5.53	5.51	1	1.08	NO ALARM
40	12843	All NBR Co	3.46	3.48	0.99	1.08	NO ALARM



Demo



<https://remus.cern.ch/PROD/statistics>



<https://remus.cern.ch/PROD/reporting>

InforEAM & HelpAlarm



InforEAM & HelpAlarm

- No possibility to aggregate the maintenance activities by MS/Channel
- SharePoint will be obsolete soon
- ...

130 Environmental Monitoring Stations

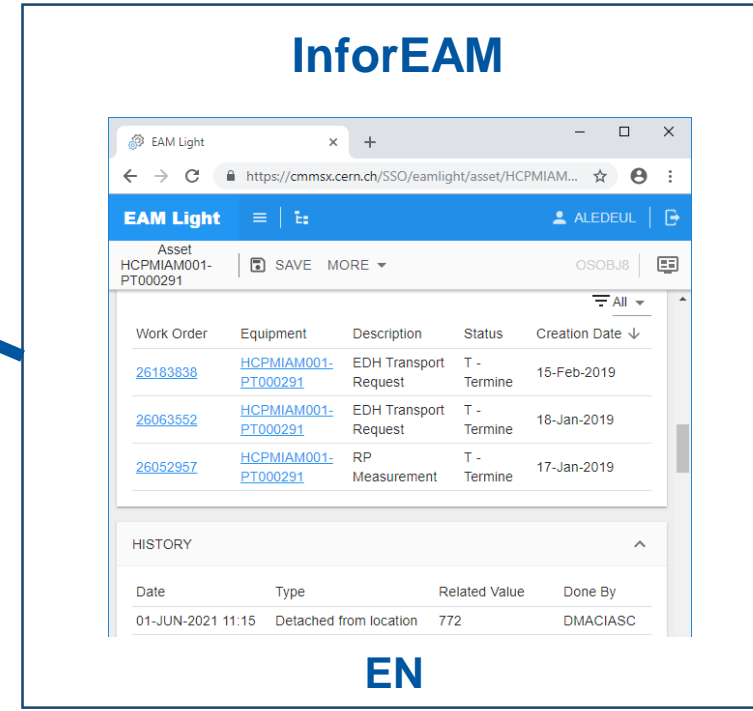
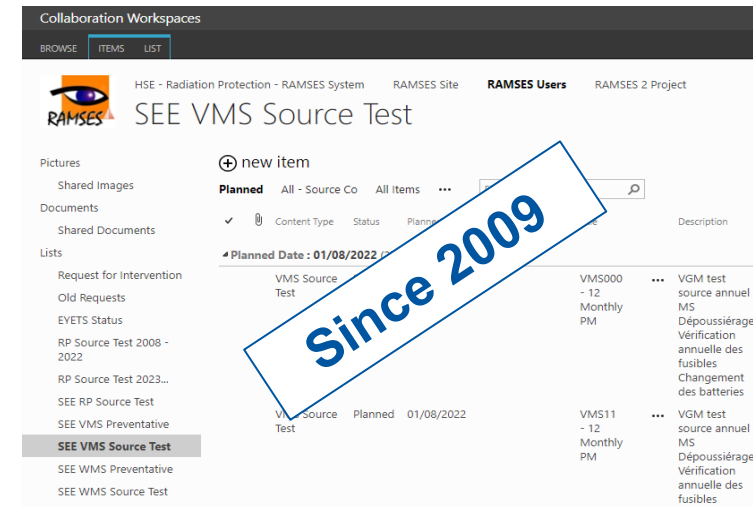


HSE

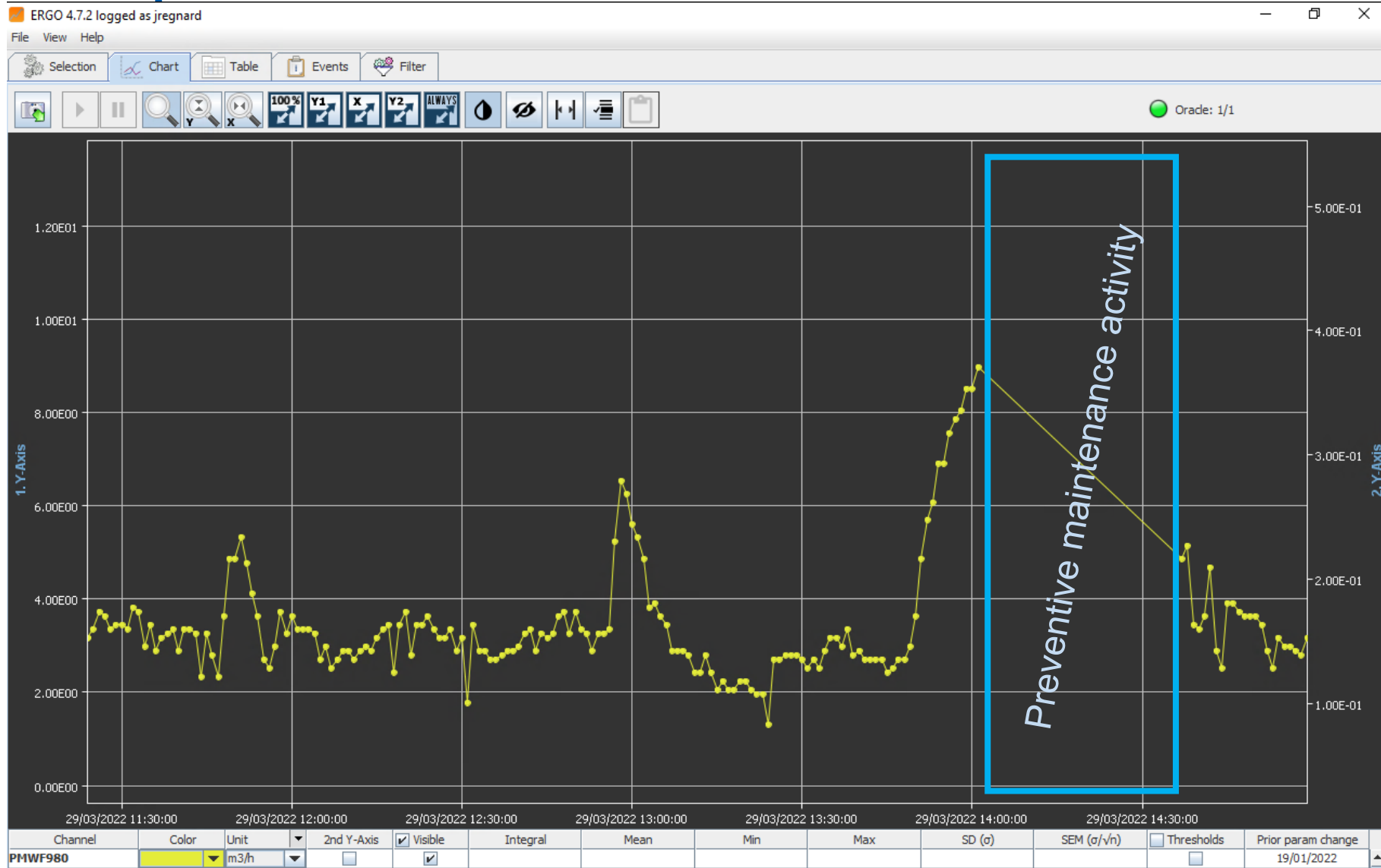
125 Mi
datapoints / year



- 2200 pieces of equipment declared
- 750 Preventive maintenance activities / year planned
- Fully operational by October 2022



InforEAM & HelpAlarm



InforEAM & HelpAlarm

REMUS - REMUS - 3.3.2

jregnard

Unack. Alarms: 9
Unack. Sys. Faults: 33

20/06/2022 10:16:52

Environmental Monitoring

Geographic Views

- > Meyrin site
- > Preveessin site
- > PS Complex
- > SPS complex
- > LHC
 - Point 1.8
 - Point 1 : ATLAS
 - Maisonnex
 - Point 2 : ALICE
 - Point 3
 - Point 4
 - Point 5 : CMS
 - Cessy
 - Point 6
 - Point 7
 - Point 8 : LHC-b

Summary Views

Channels Process Sampler MS

WMS980 EAM 20/06/2022 10:28:48

Channels Process Sampler MS

WMS980 EAM 20/06/2022 10:16:52

DEFINITION

EAM links

MS Id. / T ype: 129 SMART_WMS

Domain:

Zone: Environment (non-radioactive)

Location: 3876

MS STATUS

- 230 V
- Battery
- Charger
- NTP
- Acq. Manager
- Data Up to Date
- PLC CPU
- PLC Ethernet Card
- PLC Serial Card
- PLC Input/Output
- PLC Flash Memory
- REMUS Driver

CONFIGURATION

	Channel name	ID
CH1	PMWPH980	108
CH2	PMWTB980	109
CH3	PMWC980	110
CH4	PMWT980	111
CH5	PMWHC980	2005
CH6	PMWR980	1969
CH7	PMWF980	107

Water Monitoring

LHC Water Physicochemical Monitoring

WMS910	WMS950																		
<table border="1"> <tr> <td>SAMPLING</td> <td>NORMAL</td> <td>8.6 n.d.</td> </tr> <tr> <td>3 NTU</td> <td>619 µS/cm</td> <td>17.9 °C</td> </tr> <tr> <td>19163 n.d.</td> <td>0.000 mm/day</td> <td>25.5 m3/h</td> </tr> </table>	SAMPLING	NORMAL	8.6 n.d.	3 NTU	619 µS/cm	17.9 °C	19163 n.d.	0.000 mm/day	25.5 m3/h	<table border="1"> <tr> <td>STAND-BY</td> <td>NORMAL</td> <td>0.0 n.d.</td> </tr> <tr> <td>0 NTU</td> <td>0 µS/cm</td> <td>0.0 °C</td> </tr> <tr> <td>19756 n.d.</td> <td>0.000 mm/day</td> <td>0.2 m3/h</td> </tr> </table>	STAND-BY	NORMAL	0.0 n.d.	0 NTU	0 µS/cm	0.0 °C	19756 n.d.	0.000 mm/day	0.2 m3/h
SAMPLING	NORMAL	8.6 n.d.																	
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0 NTU	0 µS/cm	0.0 °C																	
19756 n.d.	0.000 mm/day	0.2 m3/h																	
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WMS920	WMS960																		
<table border="1"> <tr> <td>SAMPLING</td> <td>NORMAL</td> <td>7.9 n.d.</td> </tr> <tr> <td>3 NTU</td> <td>428 µS/cm</td> <td>16.5 °C</td> </tr> <tr> <td>18245 n.d.</td> <td>0.000 mm/day</td> <td>3.7 m3/h</td> </tr> </table>	SAMPLING	NORMAL	7.9 n.d.	3 NTU	428 µS/cm	16.5 °C	18245 n.d.	0.000 mm/day	3.7 m3/h	<table border="1"> <tr> <td>STAND-BY</td> <td>NORMAL</td> <td>0.0 n.d.</td> </tr> <tr> <td>0 NTU</td> <td>0 µS/cm</td> <td>0.0 °C</td> </tr> <tr> <td>19308 n.d.</td> <td>0.000 mm/day</td> <td>0.6 m3/h</td> </tr> </table>	STAND-BY	NORMAL	0.0 n.d.	0 NTU	0 µS/cm	0.0 °C	19308 n.d.	0.000 mm/day	0.6 m3/h
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0 NTU	0 µS/cm	0.0 °C																	
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WMS930	WMS970																		
<table border="1"> <tr> <td>SAMPLING</td> <td>NORMAL</td> <td>7.9 n.d.</td> </tr> <tr> <td>4 NTU</td> <td>330 µS/cm</td> <td>11.9 °C</td> </tr> <tr> <td>17803 n.d.</td> <td>0.000 mm/day</td> <td>61.8 m3/h</td> </tr> </table>	SAMPLING	NORMAL	7.9 n.d.	4 NTU	330 µS/cm	11.9 °C	17803 n.d.	0.000 mm/day	61.8 m3/h	<table border="1"> <tr> <td>STAND-BY</td> <td>NORMAL</td> <td>0.0 n.d.</td> </tr> <tr> <td>0 NTU</td> <td>0 µS/cm</td> <td>0.0 °C</td> </tr> <tr> <td>19727 n.d.</td> <td>0.000 mm/day</td> <td>0.4 m3/h</td> </tr> </table>	STAND-BY	NORMAL	0.0 n.d.	0 NTU	0 µS/cm	0.0 °C	19727 n.d.	0.000 mm/day	0.4 m3/h
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WMS940	WMS980																		
<table border="1"> <tr> <td>STAND-BY</td> <td>NORMAL</td> <td>0.0 n.d.</td> </tr> <tr> <td>0 NTU</td> <td>0 µS/cm</td> <td>0.0 °C</td> </tr> <tr> <td>19742 n.d.</td> <td>0.000 mm/day</td> <td>0.2 m3/h</td> </tr> </table>	STAND-BY	NORMAL	0.0 n.d.	0 NTU	0 µS/cm	0.0 °C	19742 n.d.	0.000 mm/day	0.2 m3/h	<table border="1"> <tr> <td>SAMPLING</td> <td>NORMAL</td> <td>8.3 n.d.</td> </tr> <tr> <td>49 NTU</td> <td>694 µS/cm</td> <td>19.5 °C</td> </tr> <tr> <td>19975 n.d.</td> <td>0.000 mm/day</td> <td>5.0 m3/h</td> </tr> </table>	SAMPLING	NORMAL	8.3 n.d.	49 NTU	694 µS/cm	19.5 °C	19975 n.d.	0.000 mm/day	5.0 m3/h
STAND-BY	NORMAL	0.0 n.d.																	
0 NTU	0 µS/cm	0.0 °C																	
19742 n.d.	0.000 mm/day	0.2 m3/h																	
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<https://cmmsx.cern.ch/SSO/eamlight/position/PEMWM01=3876>

InforEAM & HelpAlarm

160 Environmental Monitoring Stations



HSE

125 Mi datapoints / year



90 alarms requiring immediate intervention

750 Preventive maintenance activities / year

HelpAlarm

ID	Time	Status	Building	Site	Safety zone	Fault number	Fault family	Alarm description	Top name	Pho.	TM equipment
205438	Today 16:52:27	Active	SR1/R 201 (2175)	L01	1	YSPOR-0033181	ACCE_GENERALE_LHC	PORTE OUVERTE	VZ.L01.YSPOR-0033181.PORTEOUVERTE		DBC_0801
205631	Today 16:50:02	Active	SR1/R 201 (2175)	L18	18	YSPOR-0038059	ACCE_GENERALE_LHC	[SNC] PORTE OUVERTE	VZ.L18.YSPOR-0038059.PORTEOUVERTE		DBC_0801
205448	Today 16:49:51	Active	SR2/R C18 (2286)	L02	2	YSALC-01499	ACCE_GENERALE_LHC	[SNC] PORTE OUVERTE	VZ.L02.YSALC-01499.PORTEOUVERTE		DBC_0801
205602	Today 16:48:19	Active	SR5 (3968)	L05	5	YSALC-01374	ACCE_GENERALE_LHC	[SNC] PORTE OUVERTE	VZ.L05.YSALC-01374.PORTEOUVERTE		DBC_0801
206670	Today 16:38:24	Active	SR3/R 201 (2862)	L08	8	YSALC-01896	ACCE_GENERALE_LHC	PORTE OUVERTE	VZ.L08.YSALC-01896.PORTEOUVERTE		DBC_0801
172300	Today 16:36:19	Active	SR3/R 808 (3585)	L05	5	YSALC-00022	ACCE_GENERALE_LHC	ACCES LARGE OUVERT	VZ.L05.YSALC-00022.ACCESLARGE OUVERT		DBC_0801
205493	Today 16:21:16	Active	SR3/R 808 (3585)	L05	5	YSALC-00022	ACCE_GENERALE_LHC	PORTE OUVERTE	VZ.L05.YSALC-00022.PORTEOUVERTE		DBC_0801
194411	Today 16:23:29	Active	SR2/2 (SR21)	L01		UMM-00147	THER_VENT_LHC	DEFAULT MINEUR UNITE LIAIS_147	UV.L01.UMM-00147.DEF_MIN		KCE_PHAC_LHC1
174375	Today 16:13:42	Active	SR3/R (SR77)	L06		FSEAC-00073/UMM-00022	THER_VENT_LHC	DEFAULT TEMPERATURE AMBIANTE SRMS	UV.L06.FSEAC-00077.UMM-00022.DEF_PHOC		KCE_PHAC_LHC6
147460	Today 16:23:46	Active	SR2 (SR2)	L32	32	USARP/PM-903.LJWC-902	THER_VENT_LHC	DEFAULT GENERAL - FRACTION DESIREE	UV.L32.USARP/PM-903.LJWC-902.DEF_GEN_DEE		OPC_VRM/VENT/H2516_3N
149871	Today 16:23:46	Active	SR2 (SR2)	L32	32	USARP/PM-903.LJWC-902	THER_VENT_LHC	TEMPERATURE HAUTE	UV.L32.USARP/PM-903.LJWC-902.DEF_TIP_HAUTE		OPC_VRM/VENT/H2516_3N
205439	Today	Active	SR	L01	1	YSALC-01493	ACCE_GENERALE_LHC	DEFAULT LECTEUR	VZ.L01.YSALC-01493.LECTEURDEFAULT		DBC_0801

BE

InforEAM

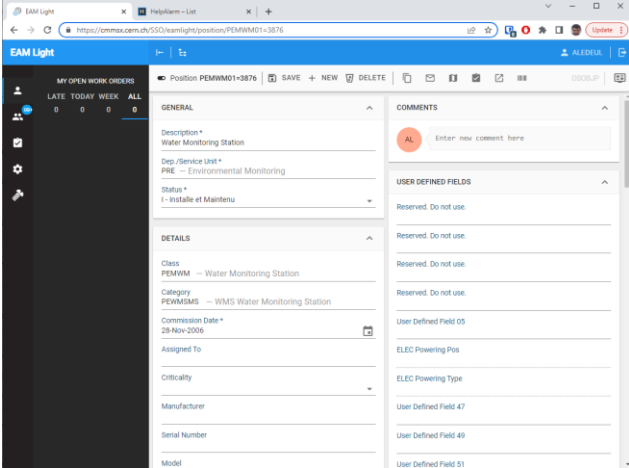
Work Order	Equipment	Description	Status	Creation Date
26183838	HCPMIAM001-PT000291	EDH Transport Request	T - Termine	15-Feb-2019
26063552	HCPMIAM001-PT000291	EDH Transport Request	T - Termine	18-Jan-2019
26052957	HCPMIAM001-PT000291	RP Measurement	T - Termine	17-Jan-2019

Date	Type	Related Value	Done By
01-JUN-2021 11:15	Detached from location	772	DMACIASC

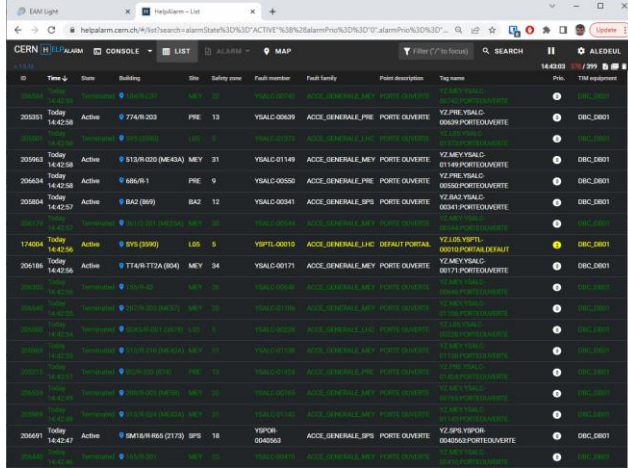
EN



Demo



<https://cmmsx.cern.ch/SSO/eamlight>

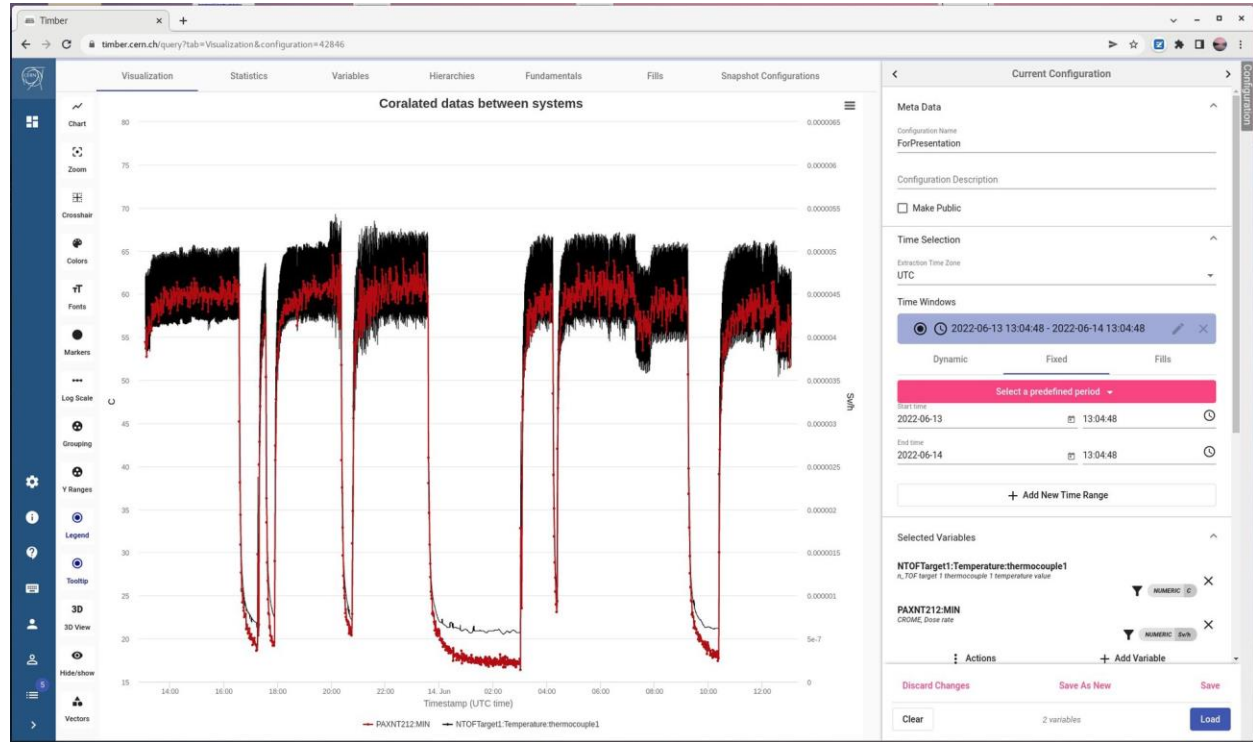


<https://helpalarm.cern.ch>



REMUS data in NXCALS/TIMBER

Data Sharing to NXCALS



TIMBER Web

HSE-CEN
HSE-RP
BE-OP
EP

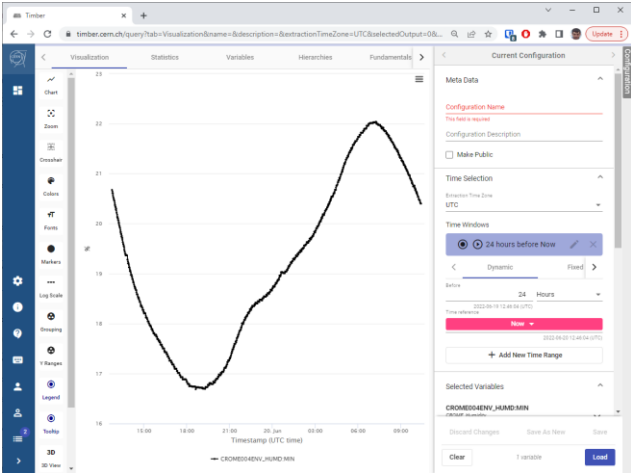
NXCALS System



CERN Control Center

- Shared Big Data storage of all CERN control systems
- Help in beam observation devices and investigate problems with accelerator equipment or unexpected beam behavior.
- Keep data for long period of time and assure good and performant analyses and data extraction by the physicists.

Demo



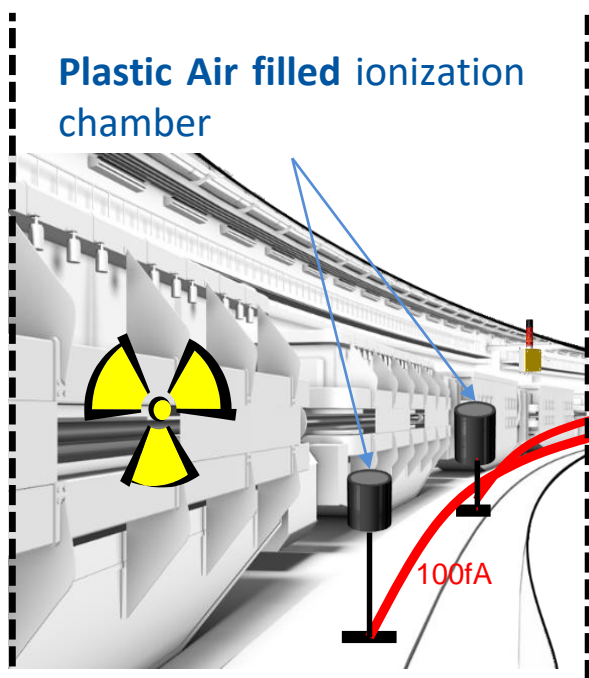
<https://timber.cern.ch>

Data Analysis using SWAN (NXCALS data)

CERN Radiation Monitoring Electronics (CROME)

Two configurations :

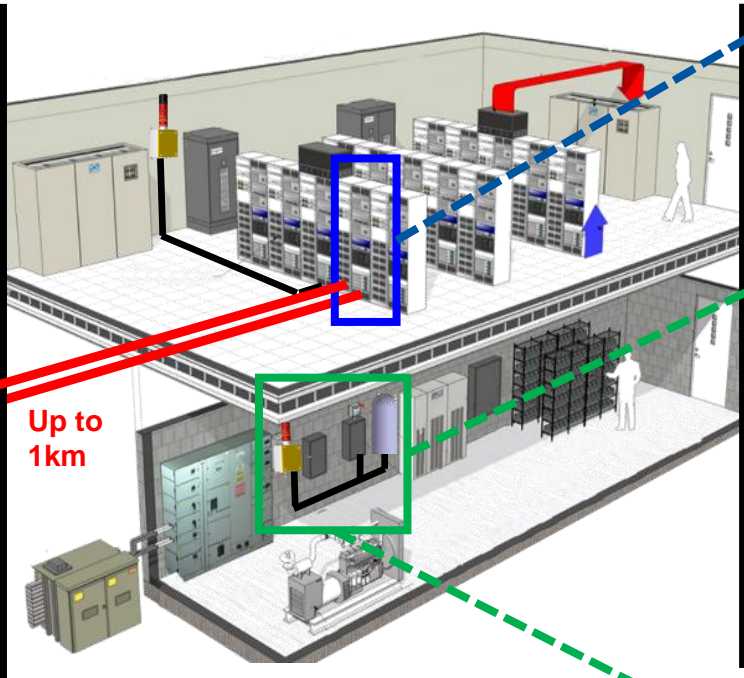
Conceptual view of CROME at CERN



SPA6 cable
1000V

100fA

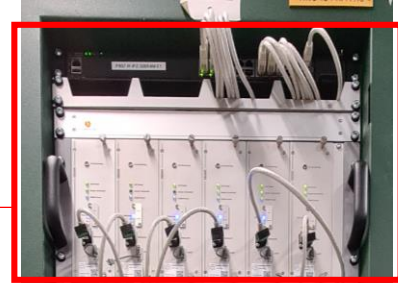
High Radiation Area



Up to 1km

Low Radiation Area

Rackable

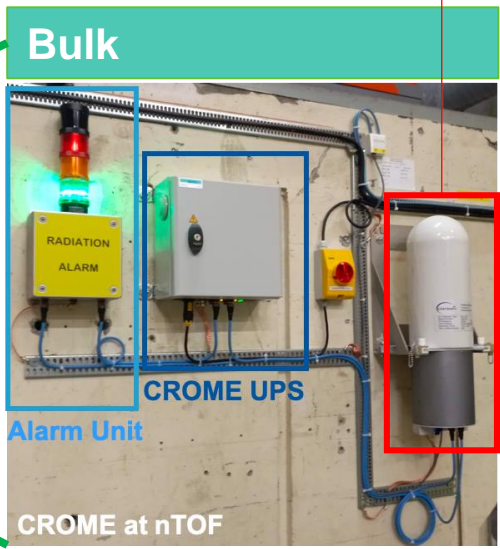


Radiation Monitoring and processing units



CROME Rack at EHN1 (North Area)

CROME Junction Box



Uninterruptible Power Supply
Includes a battery for continuous operation

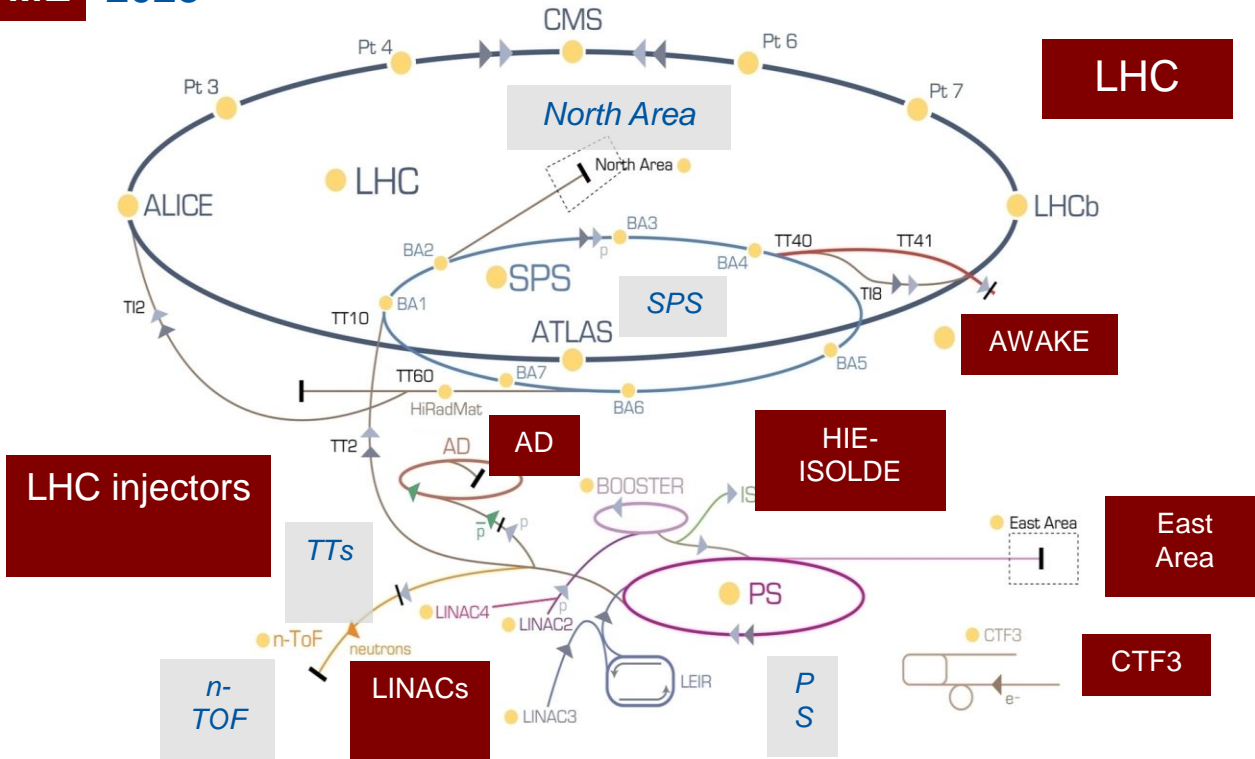


CERN - Radiation & Environmental Monitoring System

650 Radiation Protection and Environmental monitoring devices

CROME 2021

CROME 2028



Self production capabilities

Tests / validation inside climatic chambers



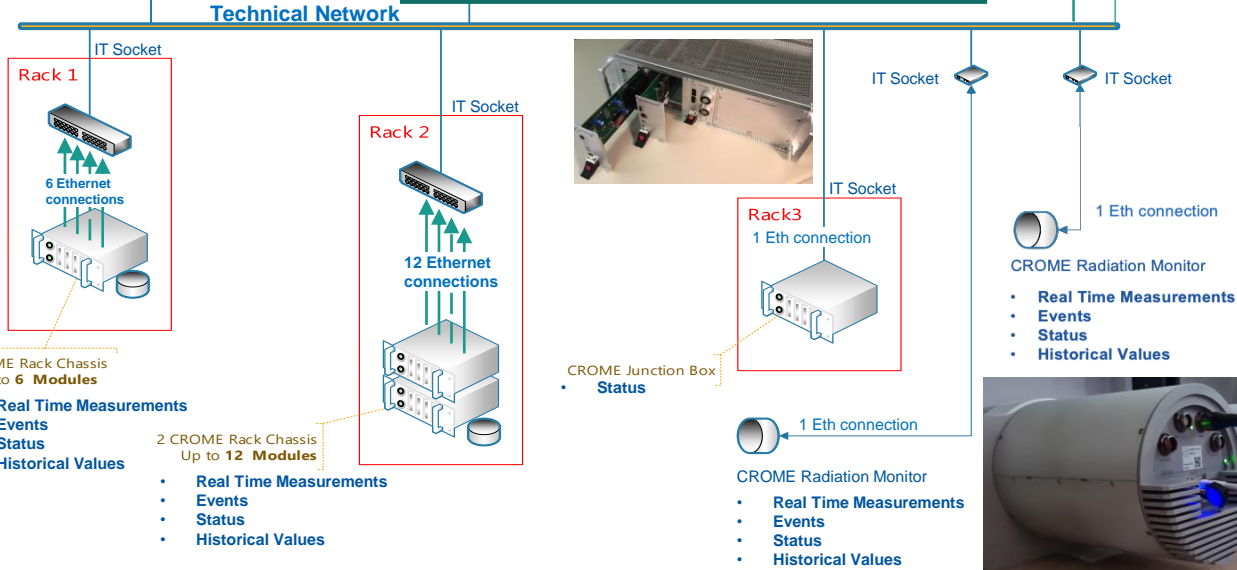
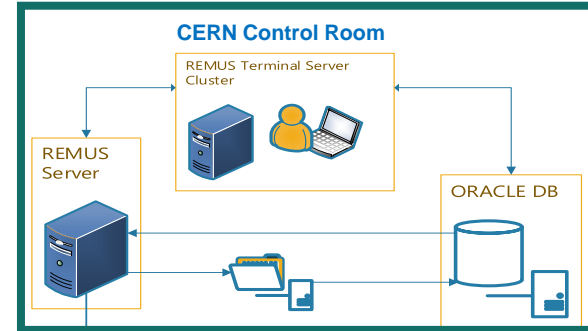
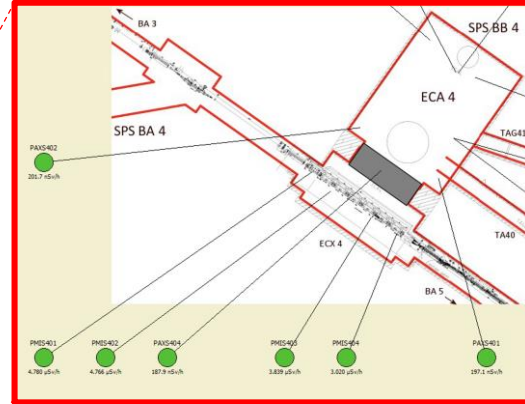
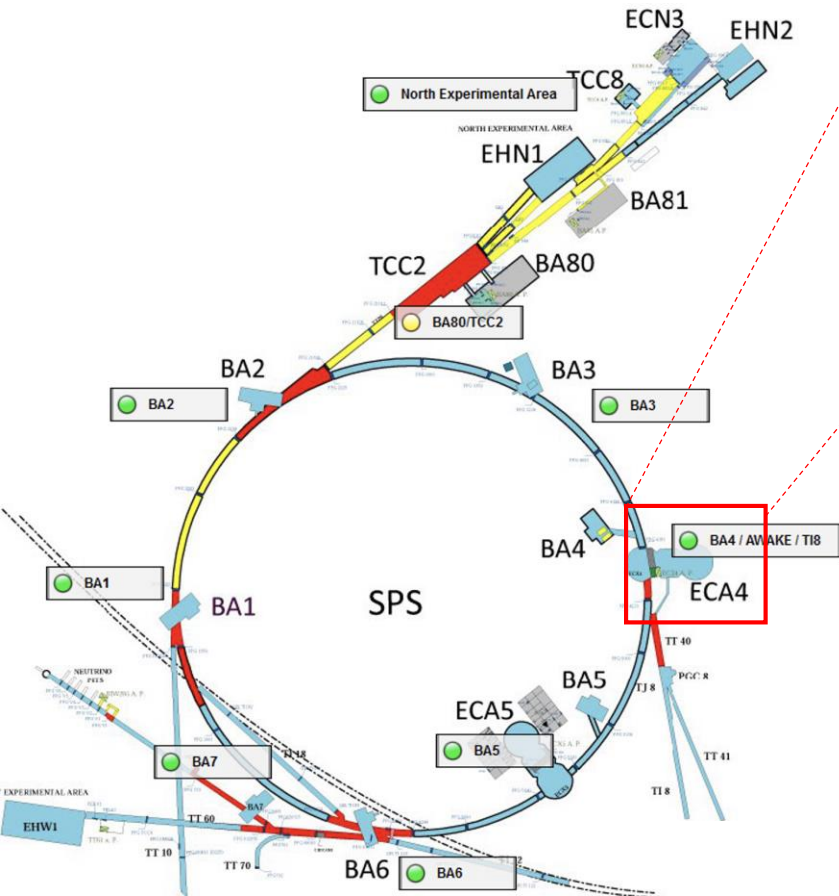
Assembly Workshop

For more info : <https://crome.web.cern.ch/node/35>



CROME/REMUS Network

ECA4 - SPS



CROME Rack Chassis
Up to 6 Modules

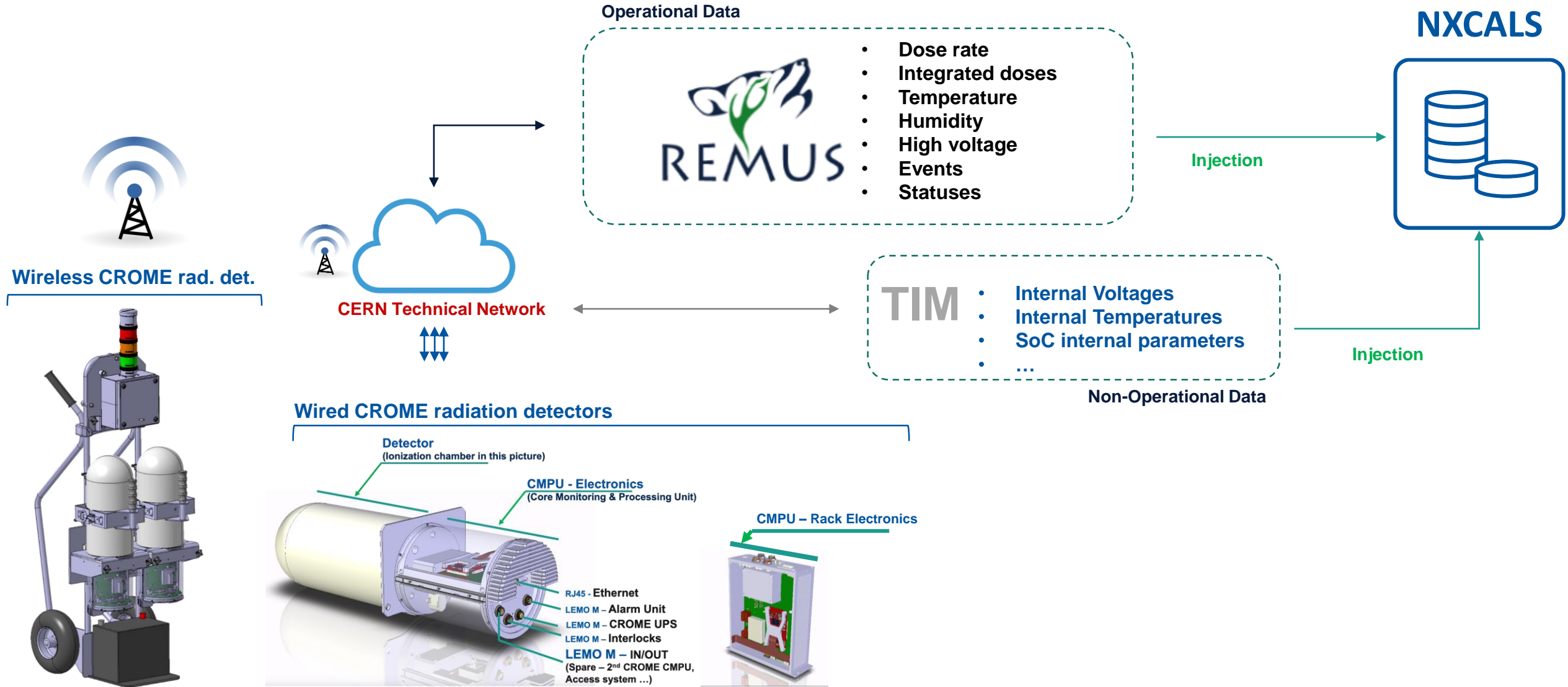
- Real Time Measurements
- Events
- Status
- Historical Values

2 CROME Rack Chassis
Up to 12 Modules

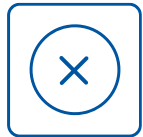
- Real Time Measurements
- Events
- Status
- Historical Values

- CROME Radiation Monitor
- Real Time Measurements
 - Events
 - Status
 - Historical Values





Work Package Overview



Currently: Data sent to NXCALS remains unused



Goal: Use data on NXCALS for Predictive Maintenance



Develop Anomaly Detection process to identify failure precursors

Challenges for Anomaly detection



- No System Failures known
- No data available that represents healthy state of system
- No definition of anomalous behavior



- Anomalies are rare and different
- Focus on noise in signals



Use multi-level wavelet transform (MRA-WT) for noise extraction

Anomaly Detection Process

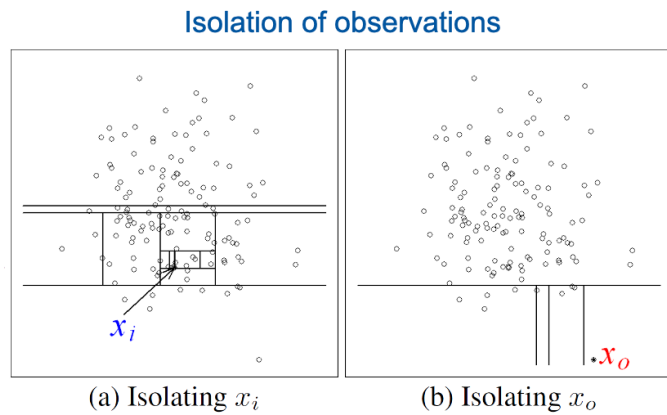
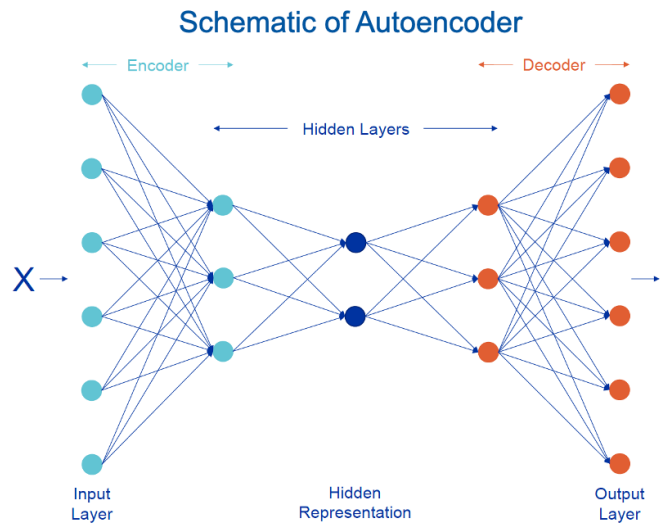
Being evaluated



Pre-Processing:

- Feature Engineering: Calculate statistical features (raw and extracted noise signal)
- Handling of Missings
- Scaling

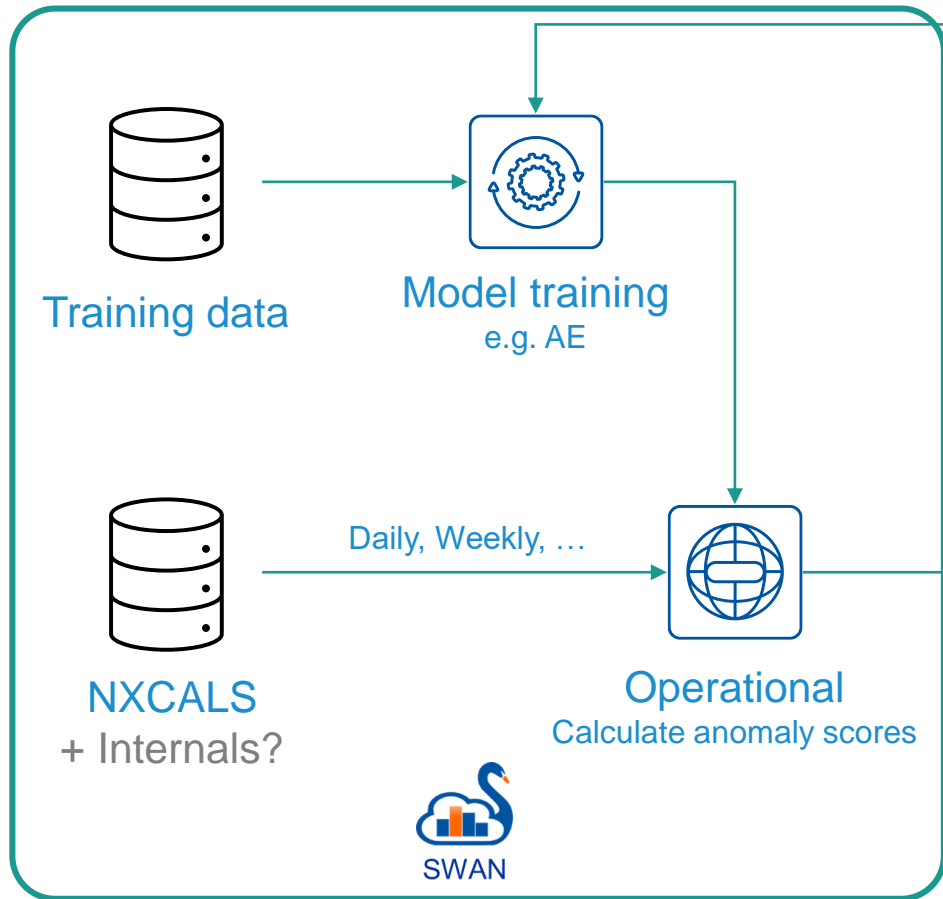
Apply Algorithms:
Isolation Forest, Autoencoder



From: F. T. Liu, K. M. Ting and Z. Zhou, "Isolation Forest," 2008 Eighth IEEE International Conference on Data Mining, 2008, pp. 413-422, doi: 10.1109/ICDM.2008.17.

Preliminary Architecture

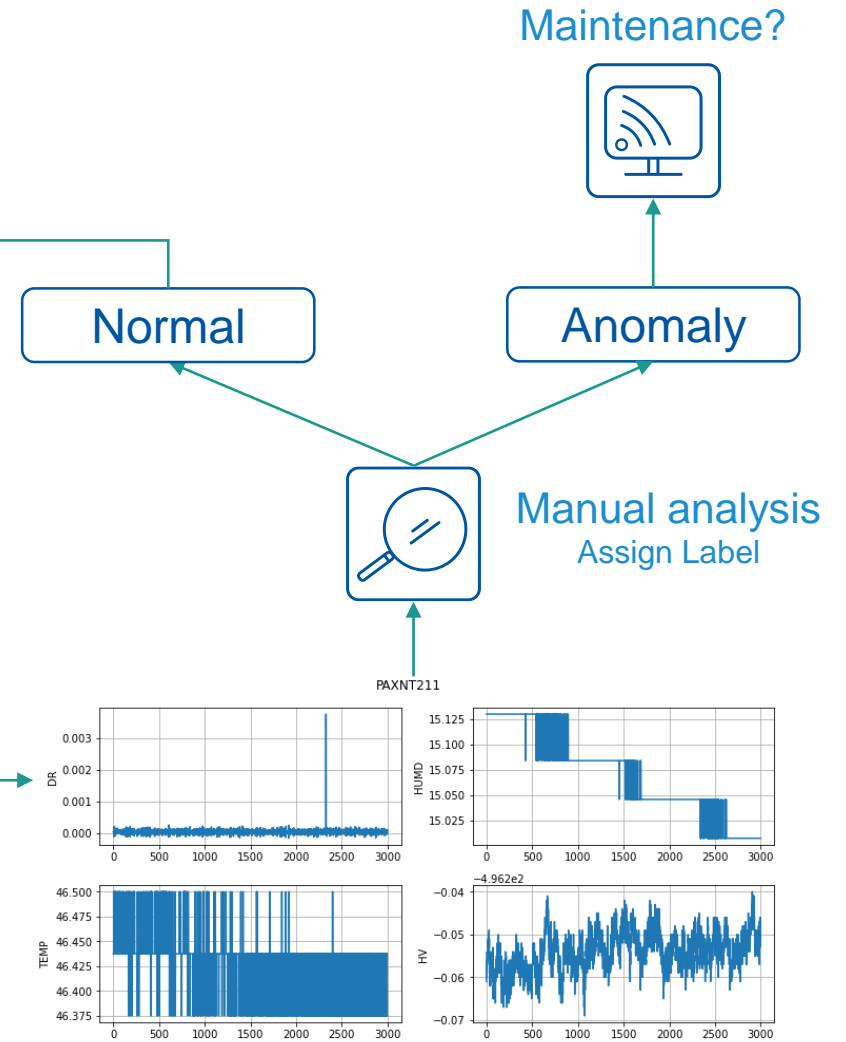
Feedback Loop



Retrain Model

Ranking

Sample	Anomaly score
PMIST214	8.564
PMINA0603	4.371
PAXNT211	2.093
...	...



Demo

```
1 package ch.cern.test
2
3 import org.apache.spark.sql._
4
5 /**
6  * Test Spark using @ Scala object
7  * This will run the method main of the object testSparkScala
8  * $bin/spark-submit --class ch.cern.test.TestSparkScala --path/target/scala-2.11/testsparkscala_2.11-0.1.jar
9  */
10 object testSparkScala {
11
12 def main(args: Array[String]): Unit = {
13
14   val spark = SparkSession
15     .builder()
16     .appName("testSparkScala")
17     .getOrCreate()
18
19   println("FizzBuzz example!")
20
21   spark.sql("""
22 select case
23   when id % 3 = 0 then "fizzbuzz"
24   when id % 3 = 0 then "fizz"
25   when id % 5 = 0 then "buzz"
26   else cast(id as string)
27 end as f12ibuzz
28 from range(1,20)
29 order by id""").show()
30
31   println("End of the example!")
32
33   spark.stop()
34 }
```

<https://swan.cern.ch>

Find the tutorial here : <https://gitlab.cern.ch/hboukaba/nxcals/>

Conclusion

Summary

Evolutions necessary for the operation

- **REMUS Web**
 - REMUS data analysis gateway
- **REMUS Web Dashboards**
 - Share data summary with other
- **REMUS Web Statistics & Reporting**
 - Efficiently generate reports for analysis and reporting
- **InforEAM & HelpAlarm**
 - Interface CERN-wide Maintenance and Alarm systems
- **REMUS data in NXCALS/TIMBER**
 - Long term Data storage at high resolution
 - Allow comparison and correlation with other control systems' data
- **REMUS data in NXCALS/SWAN**
 - Extended big-data analysis capabilities

What's next? : REMUS Web Application Editor

Ease REMUS Application Edition

The screenshot displays the REMUS Web Application Editor interface. The browser address bar shows the URL `remus-dev.cern.ch/PROD/applicationEditor/9`. The page title is "RPOperation Mise à jour PS-complex PMI Booster mmarcand 21st Sep 2020 11:37". The interface is split into several sections:

- Left Sidebar:** Contains navigation icons for Home, Trends, Alarms, Dashboards, Statistics, Reporting, Notifications, Monitoring Groups, Heatmap, Admin, Application Editor, and Grafana.
- Project Tree:** Shows a hierarchical view of the project structure:
 - PS Complex
 - Linac 2
 - Linac 3
 - Linac 4
 - Accelerator
 - Klystron hall
 - Booster
 - ISOLDE
 - All stations (RAMSES)
 - RAMSES 179 & 838
 - RAMSES 170-1
 - RAMSES 170-R
 - All stations (GRAMS)
 - GRAMS 179
 - GRAMS 170-R
 - GRAMS 170-1
 - GRAMS 197-R
- Components Contained
 - equipment : channel 10152
 - equipment : channel 10153
 - equipment : channel 10154
 - equipment : channel 10155
 - equipment : channel 10160
 - equipment : MS 1111

- Properties Table:** A table with two columns: Properties and Values.

Properties	Values
category	channel
equipmentId	11731
posX	17
posY	258
targetX	282
- Main Diagram:** A detailed floor plan of the ISOLDE facility. Various rooms and components are labeled, including R-001, R-002, R-003, R-005, R-006, R-021, R-023, R-025, R-027, R-031, R-033, R-029, R-101, and R-202. Numerous components are highlighted with green dashed boxes and labeled with codes like PAGIS007, PAHIS003, PAGIS109, PAGIS006, PAHIS002, PAGIS005, PAHIS001, PAGIS004, PAGIS003, PAGIS001, PAGIS002, PAGIS105, PAGIS101, PAGIS102, PAGIS103, and PAGIS104.
- History Table:** A table on the right side showing the history of updates.

Comment	User	Updated
	jgruber	20.08.2021 10:46
	jgruber	19.08.2021 18:58
	jgruber	12.08.2021 16:54
	jgruber	27.07.2021 11:23
	jgruber	15.07.2021 14:22
	jgruber	28.10.2020 14:36
	mmarcand	21.09.2020 11:54
	mmarcand	21.09.2020 11:45
Mise à jour PS-complex PMI Booster	mmarcand	21.09.2020 11:37
	jgruber	21.08.2020 17:13

What's next? : Net Ambient Doses and Releases Reports

A step further into Knowledge Integration

- Streamline the generation of adjusted Ambient Doses and Releases Reports
 - Increase reliability of data treatment
 - Minimize risk of human error
 - Guaranty repeatability and traceability

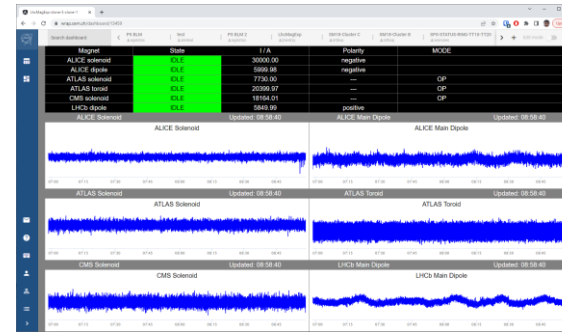
The image shows three overlapping document pages from the EDMS system. The top page is a title page for 'OCCUPA ENVIR' and 'REMAC - REM'. The middle page is section '4 TRANSFORMA' with a table of 'PREVIOUS/NEXT VERSION' and a list of 'ADD / REMOVE' items. The bottom page is section '5.3 INTEGRATED VALUES CALCULATIONS' with a list of parameters and their definitions. Each page has a CERN logo and a header with 'EDMS' and 'Status Draft'.

Net Ambient Doses and Releases Reports functional specifications.
Credit: F. Malacrida (HSE-RP)

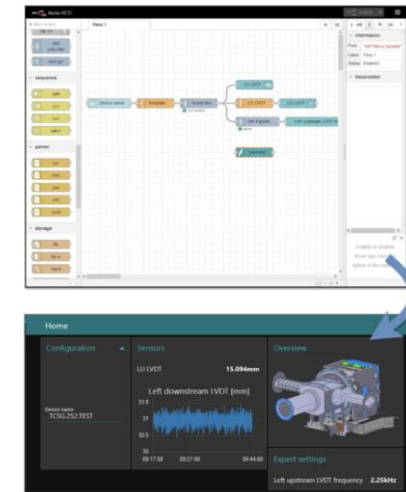
A glimpse into the future

Other CERN Web Technologies Projects for Control Systems

- Growing trend in Industrial Control Systems at CERN and beyond
- CTTB Working group
 - Web Technologies task Force
- W.R.A.P. (BE-CSS)
 - Cross-system live charts
- Flow Project (EN-SMM/BE-CEM)
 - Live web widgets



WRAP. Credit: BE-CSS



Flow Project. Credit: BE-CEM

CTTB = ATS Common Hardware & Software Technologies Technical Board
WRAP = Web Rapid Application development Platform

Thank you!

Questions



www.cern.ch

