How the PI System Can Support an Energy Management System in a Copper Company

Presented by **Thorsten Stölcken**
Philipp Kohne

Aurubis

Agenda

- About Aurubis AG
- Energy Management Systems (EnMS) and how they are made
- Measurement monitoring using PI AF
- Visualization
- Conclusion

Aurubis Group production sites

Production sites

BU Primary Copper:

- Hamburg DE
- Pirdop BG

BU Copper Products:

- Avellino IT
- Buffalo US
- Dolný Kubín SK
- Emmerich DE
- Fehrbellin DE
- Hamburg DE
- Lünen DE
- Mortara IT
- Olen BE
- Pori FI
- Röthenbach DE
- Smethwick GB
- Stolberg DE
- Zutphen NL

- Aurubis has a service and sales network in more than 20 countries (Europe, Asia and North America)

Aurubis' strengths include productivity, efficiency, environmental protection and processing expertise

Aurubis: an integrated copper producer

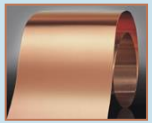
Raw materials

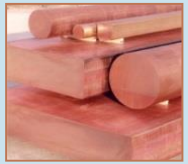
BU Primary Copper

- Cathodes
- Sulfuric acid
- Precious metals
- Tramp metals

BU Copper Products

- Cathodes
- Wire rod
- Shapes
- Flat rolled products
- Specialty profiles





Processors and end users

Aurubis production figures

Processed Cu concentrate:	2.3 million t/a
Processed Cu scrap:	0.7 million t/a
Cathode output:	1.1 million t/a
Rod output:	0.7 million t/a
Shape output:	0.2 million t/a
Employees:	6,300 total
	2,300 in Hamburg

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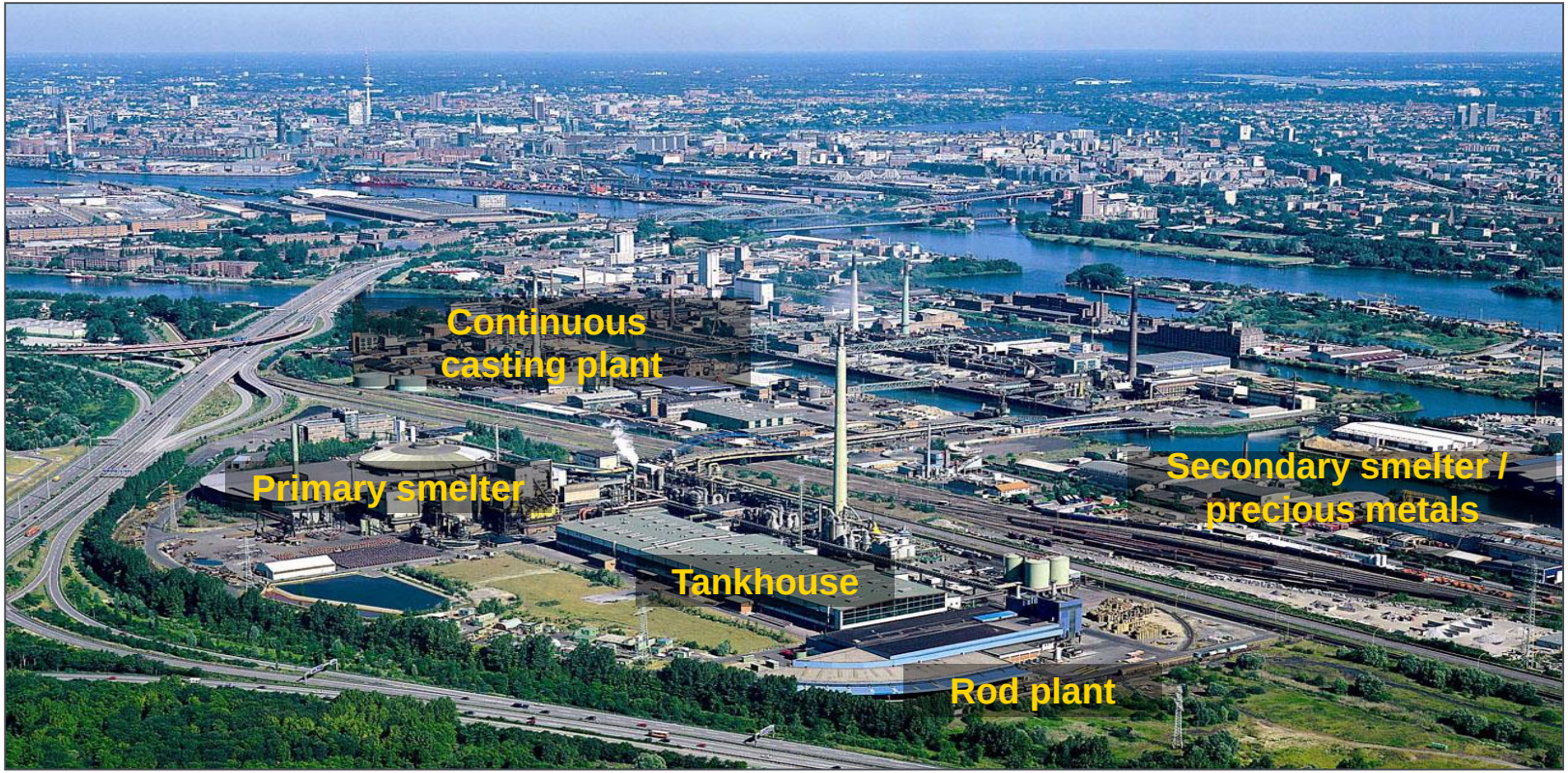
Aurubis' main production plant in Hamburg – a downtown copper smelter



Aurubis Hamburg – an energy-intensive plant site

- Electricity: 650,000 MWh/a – 90 MW peak
- Natural gas: 550,000 MWh/a – 115 MW peak
- Steam: 400,000 t/a
- Oxygen, compressed air, cooling water, coal, HFO …

Energy costs:
More than € 50 million ($ 55 million) per year

Why implement an Energy Management System (EnMS) in accordance with ISO 50001?

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Energy is becoming an increasingly important issue for companies:

- Energy costs are an important factor, especially additional costs are rising
- Environmental protection is needed, sustainability in focus

An Energy Management System in accordance with ISO 50001 provides a systematic approach in detecting ways to increase energy efficiency and lower energy costs. The certificate documents this for the public and authorities.

The PI System is a very good tool to support this and, as such, is necessary to have.

It is not the Energy Management System.

And:
Only implemented energy efficiency projects or changes in behavior save energy!

Aspects considered for the development of an EnMS in accordance with ISO 50001, part 1

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An EnMS is a management system that requires strong support from the management:

- The company has to give an commitment to efficient energy usage and energy targets.
- Sufficient employees and money have to be provided.
- A responsible person has to be appointed who directly reports to the management.
- All production units, the purchasing dept., the engineering dept., etc. have to be included.
- Energy performance indicators have to be developed and checked.
- Processes should be transparent and documented.
- Energy optimization projects have to be implemented.
- The system has to be certified by an external certifier such as TÜV, Norske Veritas …

The PI System cannot help in these areas.

Aspects considered for the development of an EnMS in accordance with ISO 50001, part 2

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But here the PI System can help perfectly:

- Energy flows should be transparent. ✓
- Energy flows have to be analyzed. ✓
- Possibilities for energy optimization have to be identified; implemented projects have to be monitored. ✓
- A data storage system has to be installed. All data has to be comprehensible; data validation is very important. ✓
- Incorrect measurements have to be detected and replaced. ✓
- Energy reports have to be issued regularly, as well as an annual management review. ✓

=> See how it is made =>

Data security, analyses, energy reports

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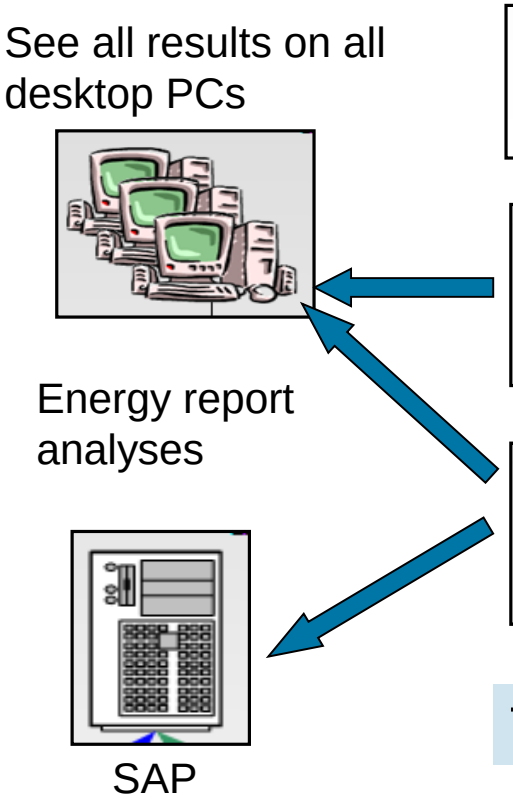


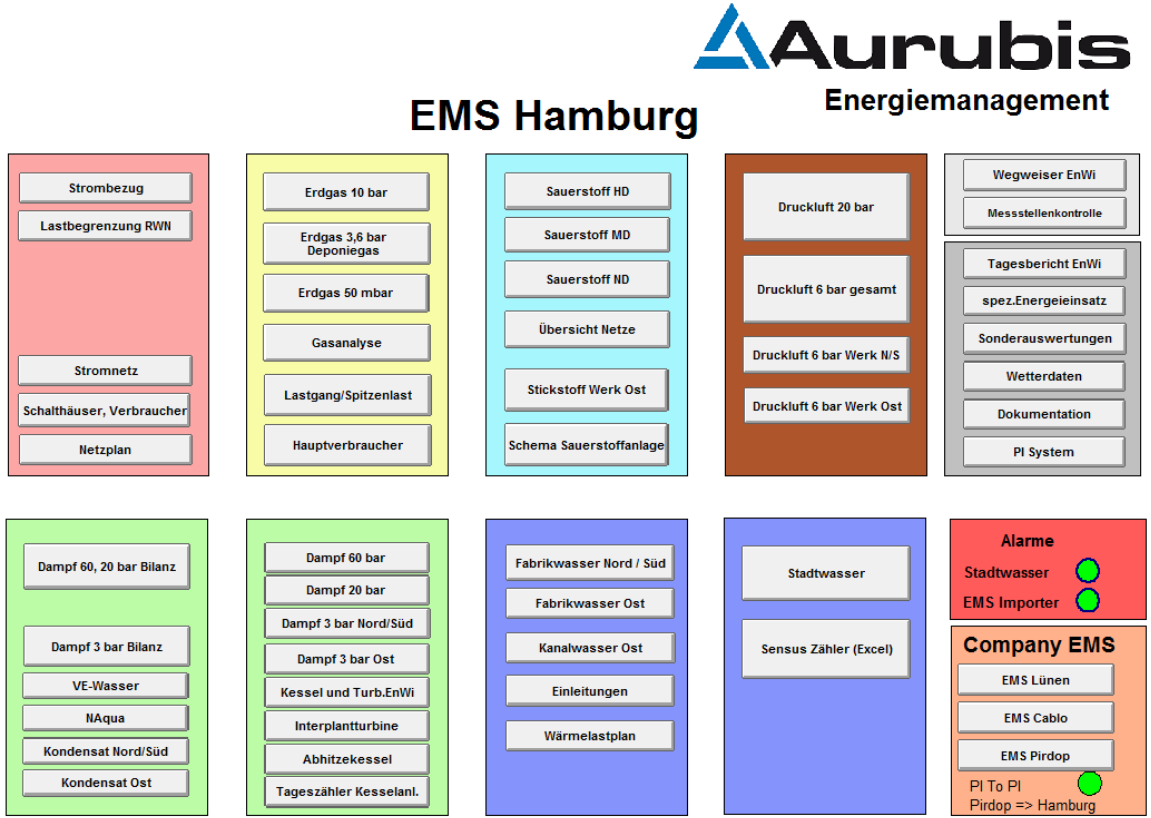
All measurements of more than 50 PLC connected via OPC (by using a buffer) to the PI Data Archive

All metering data stored in PI Data Archive; specific calculations in PI System tags and PI AF

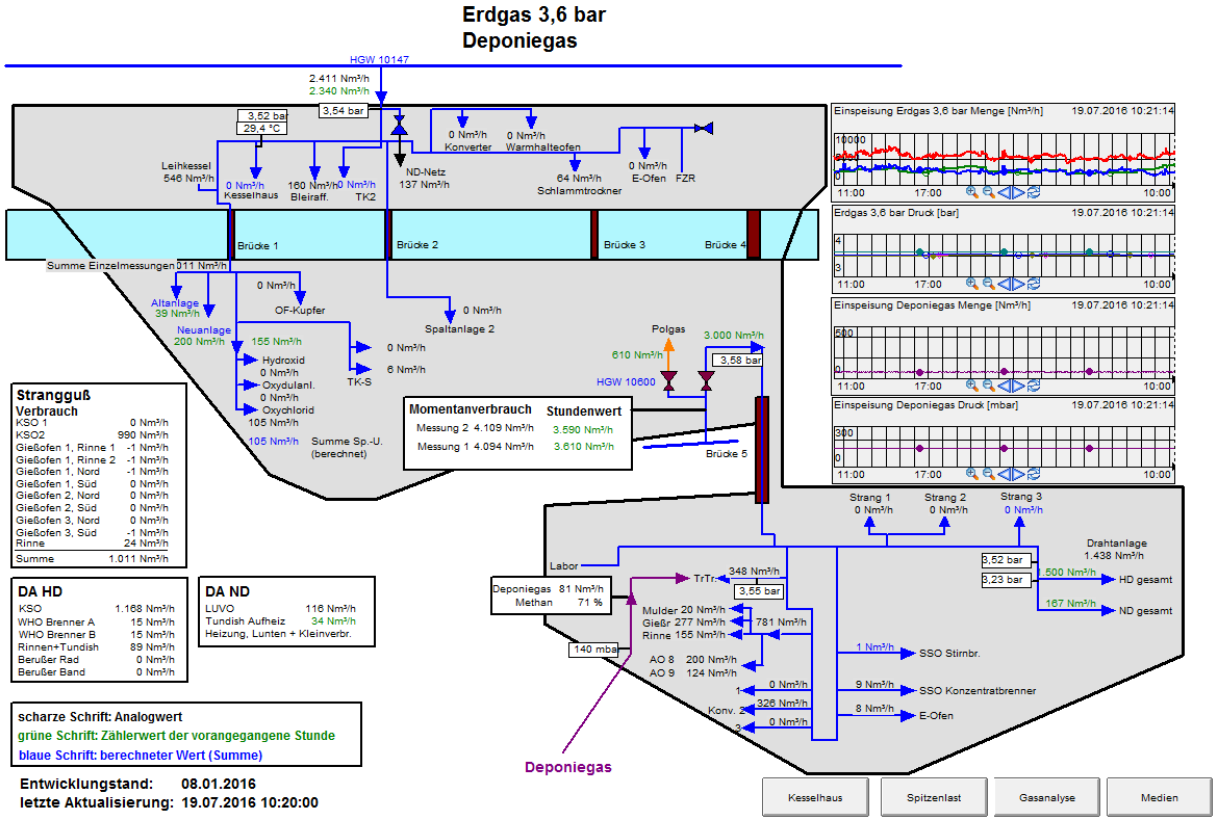
The EMS server is used for energy accounting, related to SAP cost accounting positions, and archives the results in an SQL database; SAP interface via XML

The system was built in cooperation with **Plantsoft**

Startup screen of the monitoring system using PI ProcessBook



Overview of our network; natural gas as an example



More detailed information below this overview by clicking the button

Costs and benefits of the EnMS in Hamburg

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Costs: **€ 1 million**, mostly for metering devices;
2 employees working for Energy Management

Benefits:

- Energy balances
- Monthly energy calculation to costs centers
- Optimized operation mode
- Energy efficiency projects and controlling
- Forecasts for energy
- Delivery of all data and reports to the board, authorities …
- Direct savings: **€ 0.5 – € 1 million/a**
- Savings as a result of saving projects: **€ 0.5 million/a**
- According to German law, you have to pay less tax if you run a 50001 system: **some xx € million/a**

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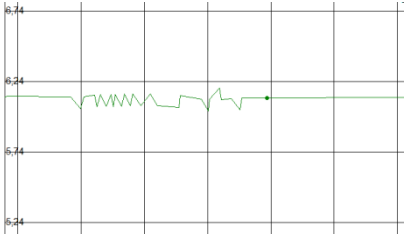
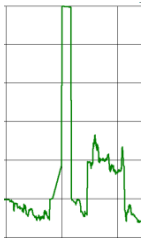
Why monitor all energy measurements?

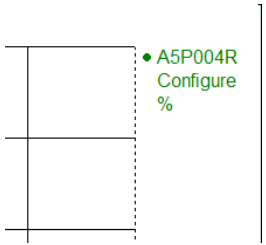
- Data of energy measurements in the PI System is the basic data for
  - Energy KPIs
  - Energy optimization projects and controlling
  - Basis for cost center calculation
- Reliable data is a core demand of the certification (50001)



Same value

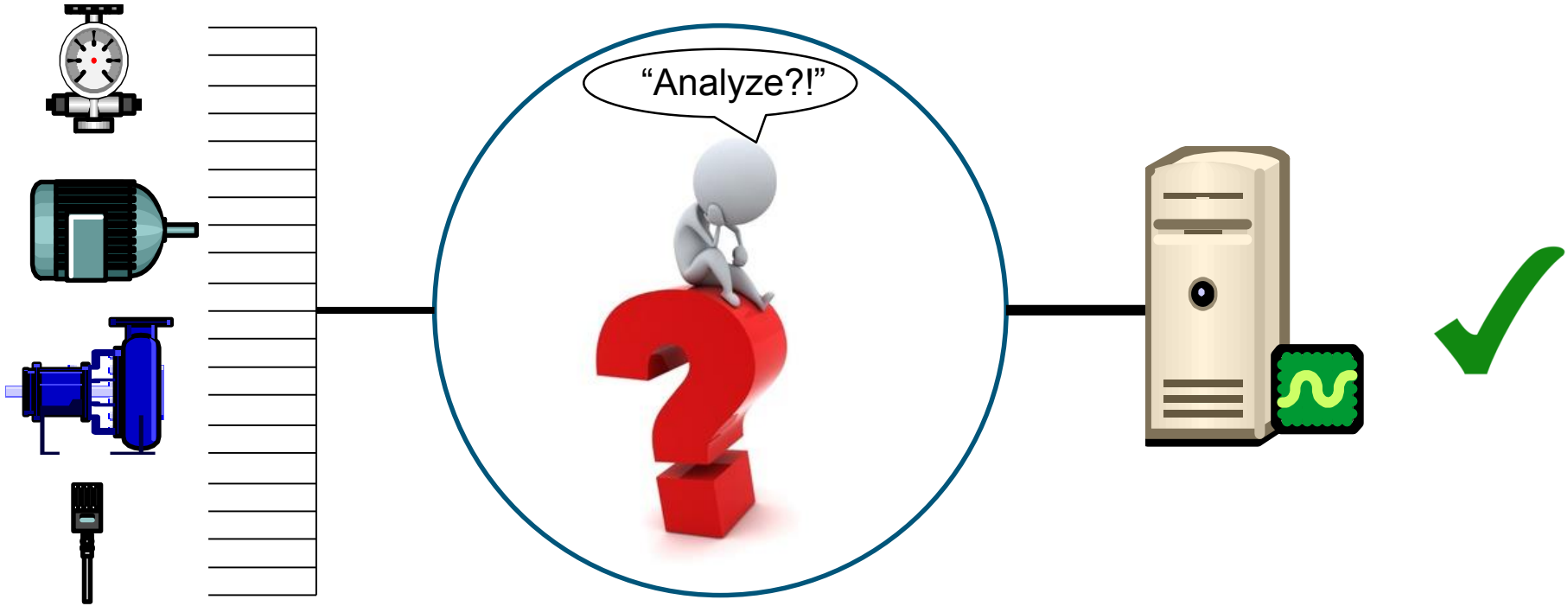


Peak value



Configure, no data …

Challenge:
How to monitor more than 3,000 measurements?



Workflow

- Provide an overview of all available measuring devices.
  → previously: check all PI ProcessBook Display Files you work with
    → e.g. flow, pressure or temperature measurements
- Link and compare statistical data from other data sources to create a detailed analysis
- Create a structure to analyze all measurements
  → Get an automatic system

Workflow

- Implement analyses that are working in the background
  → Use generally applicable algorithms
- Systematically detect sensor failure
- Store the results
- User-friendly interface
  → The client should be able to find and analyze measurement failures easily

The use of PI Asset Framework (PI AF)
→ Structure of assets in elements

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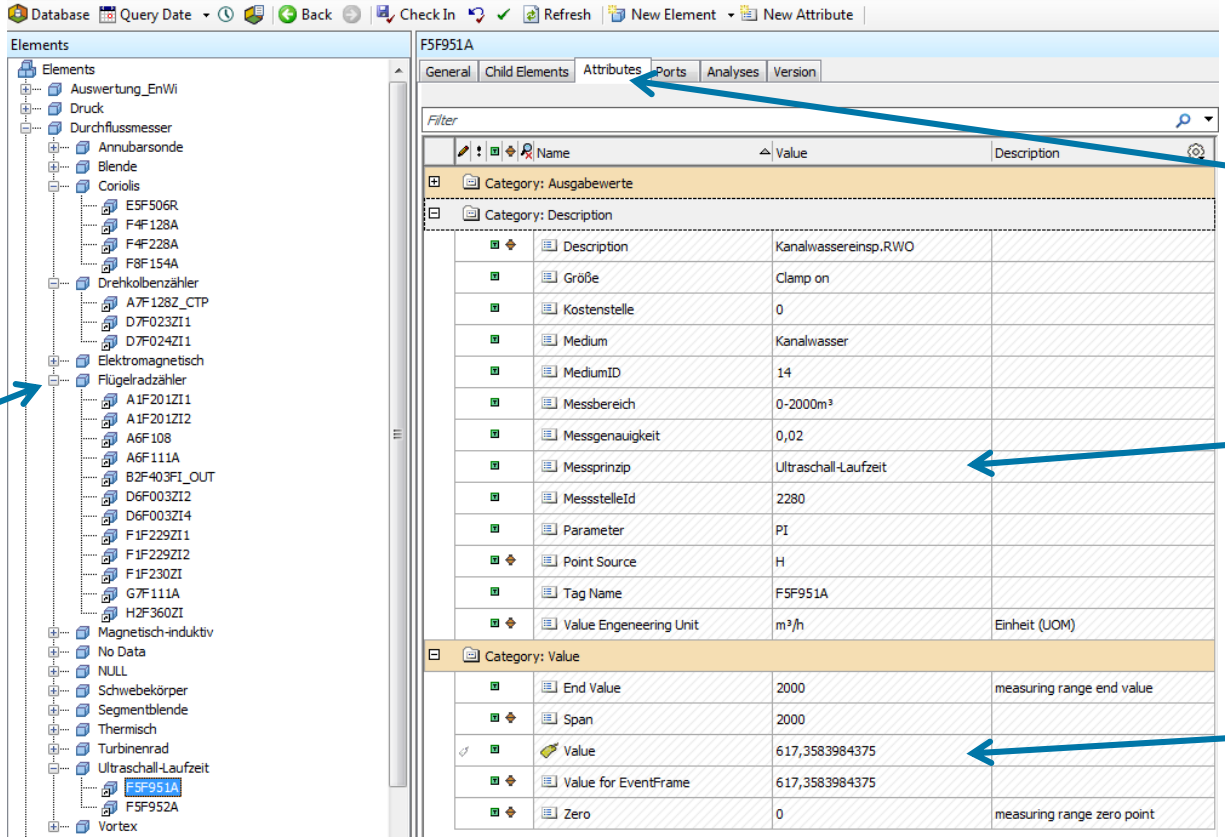


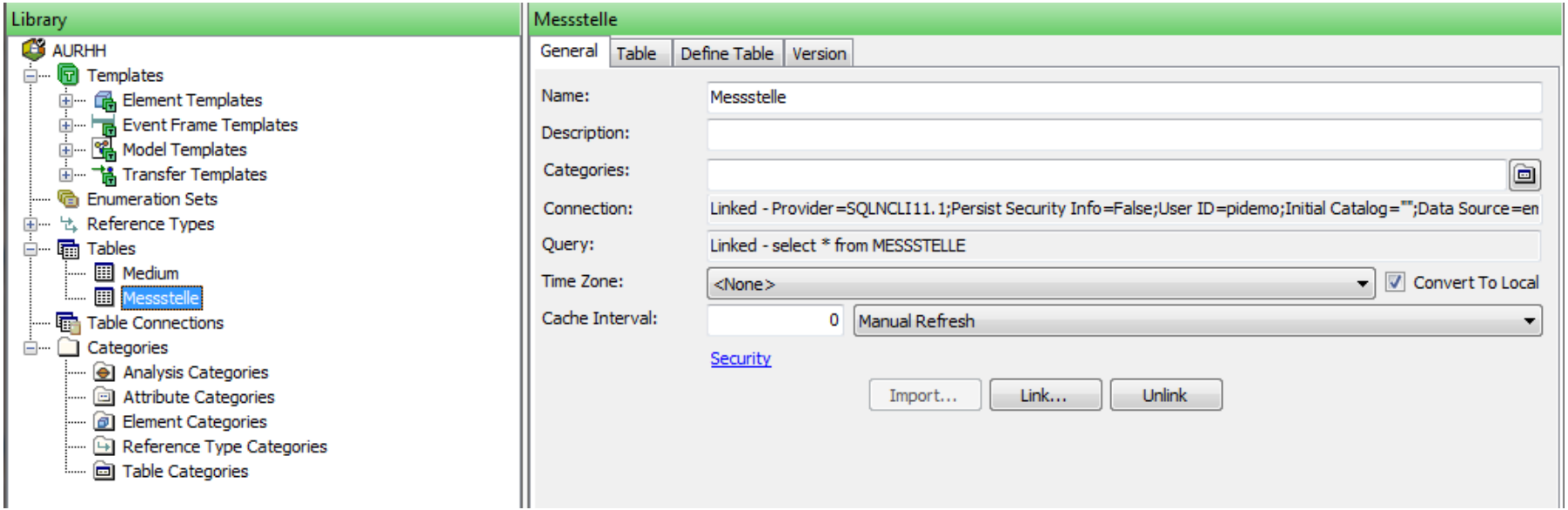
Structure of elements

Store information in Attributes

From EMS-SQL-Database

From PI Data Archive

How to link other relational database to get more information



The use of templates to create a large number of same type measurements

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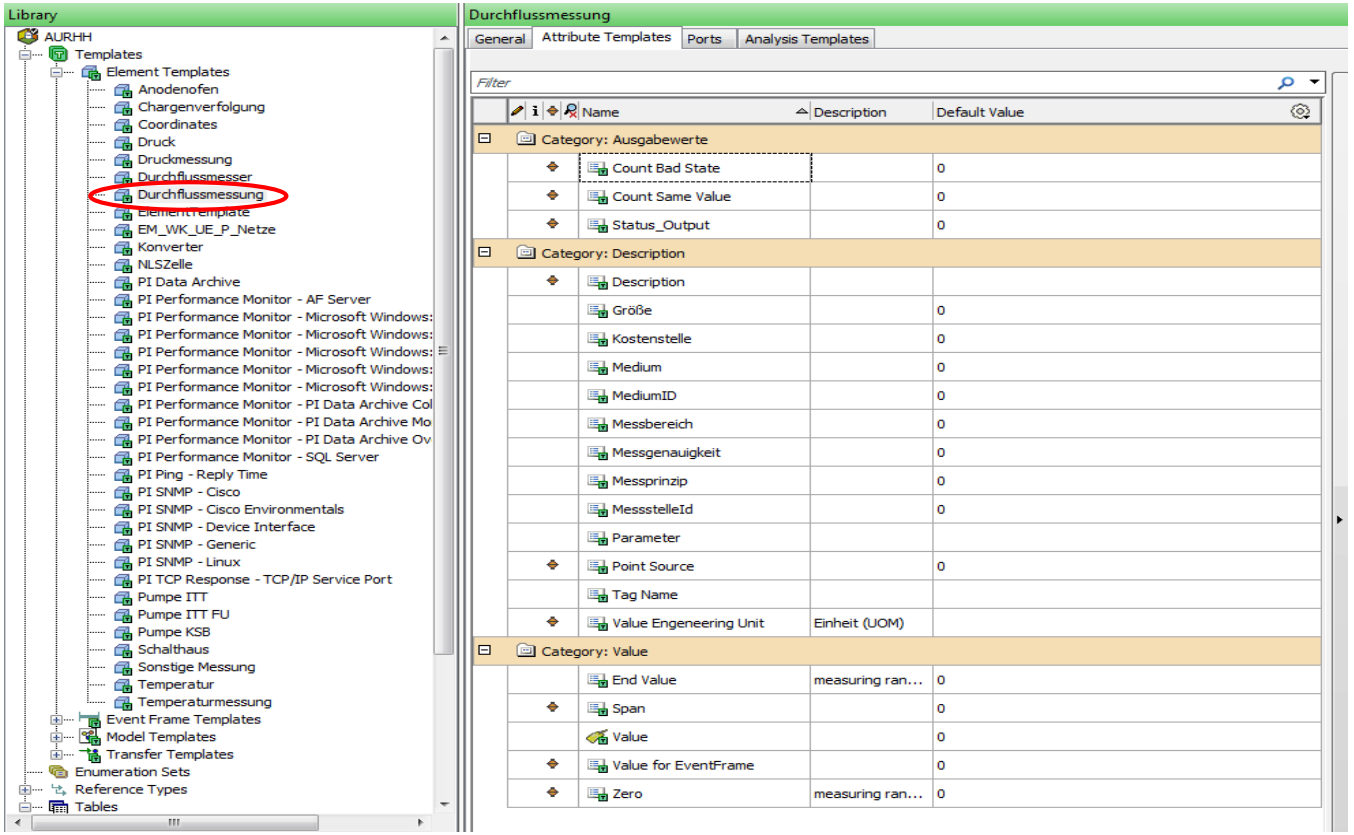
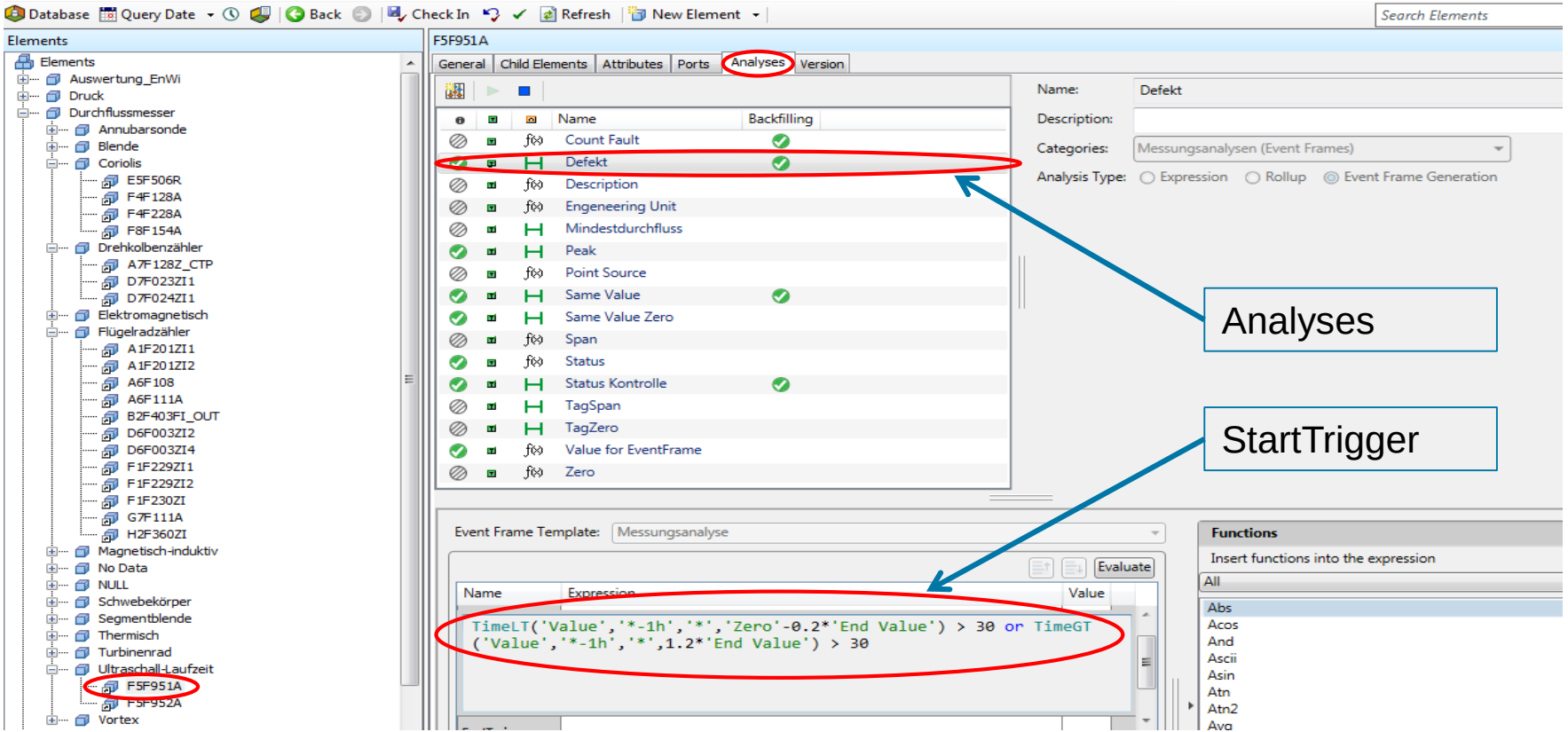
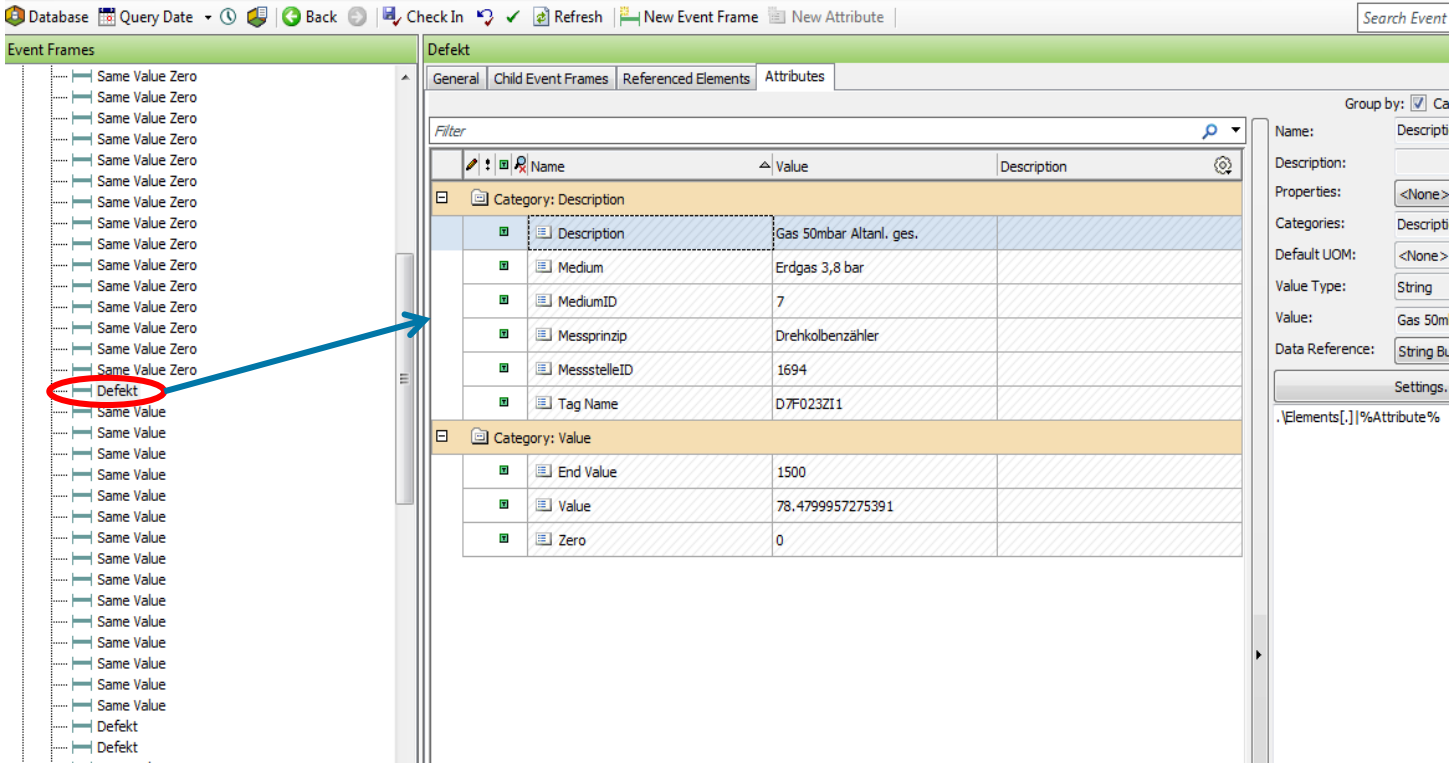


Generation of analysis to detect a failure of a measurement



Generation of Event Frames



The Event Frame stores start and end time of each event

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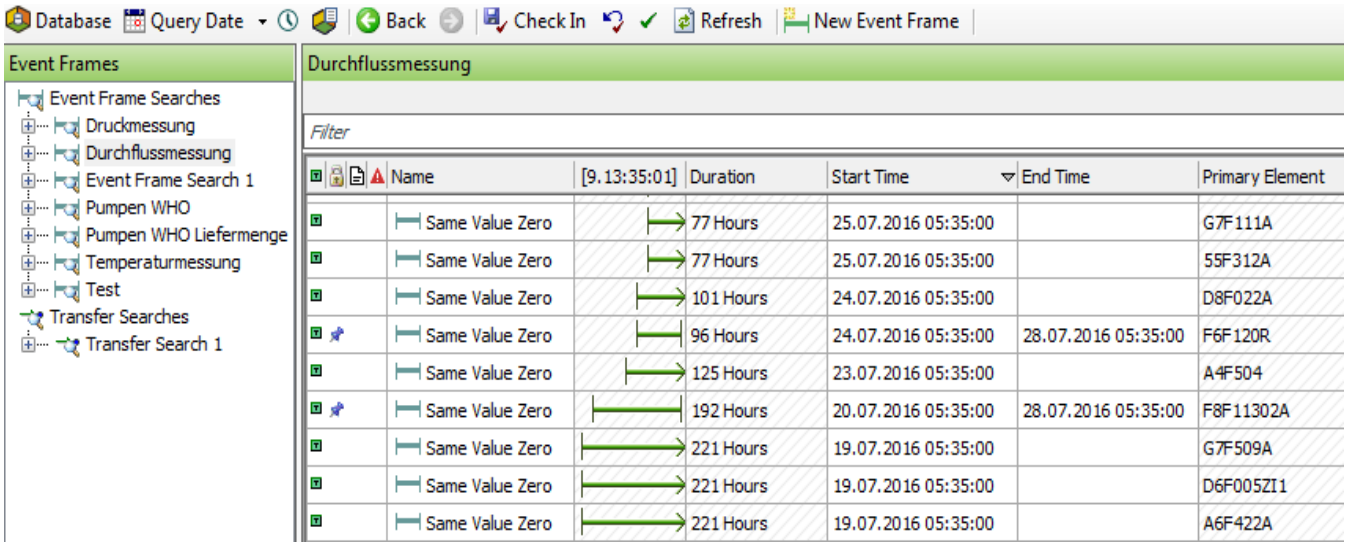
Visualization

- PI System Explorer is not adapted for a general user



Name	[9.13:35:01]	Duration	Start Time	End Time	Primary Element
Same Value Zero		77 Hours	25.07.2016 05:35:00		G7F111A
Same Value Zero		77 Hours	25.07.2016 05:35:00		55F312A
Same Value Zero		101 Hours	24.07.2016 05:35:00		D8F022A
Same Value Zero		96 Hours	24.07.2016 05:35:00	28.07.2016 05:35:00	F6F120R
Same Value Zero		125 Hours	23.07.2016 05:35:00		A4F504
Same Value Zero		192 Hours	20.07.2016 05:35:00	28.07.2016 05:35:00	F8F11302A
Same Value Zero		221 Hours	19.07.2016 05:35:00		G7F509A
Same Value Zero		221 Hours	19.07.2016 05:35:00		D6F005ZI1
Same Value Zero		221 Hours	19.07.2016 05:35:00		A6F422A

- A new interface has to be created

End-user friendly interface
→ Excel and the add-in ‘PowerPivot’

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Aktualisieren | Trend

Jahr: 2016

Monat: 7

Tag: 19

EventFrame Status: Aktiv

Messung: Durchflussmessu...

EventFrame Name: Same Value Z...

EventFrame Name	Tag Name	EventFrame Start Time	EventFrame End Time	Description	Medium	Messprinzip	Value	Anzahl
Same Value Zero	30F012ZI	19.07.2016 05:35	(Leer)	Erdgas 3,8bar RWN E-Ofen	Erdgas 3,8 bar	Turbinenrad	0	6
Same Value Zero	A1F201ZI1	19.07.2016 05:35	(Leer)	Wasser 301-001 HZ Hauptlabor	Stadtwasser m. Siel	Flügelradzähler	0	6
Same Value Zero	A7F214A	19.07.2016 05:35	(Leer)	DL 6bar CIS	Druckluft 6 bar, trocker	Annubarsonde	0	2
Same Value Zero	B1F001A	19.07.2016 05:35	(Leer)	Gas 50mbar Bemusterung Probenahme	Erdgas 0,05 bar	Blende	1.2982474565506	5
Same Value Zero	B1F202ZI	19.07.2016 05:35	(Leer)	Gas 50mbar Edelprobe Aufheizstation	Erdgas 0,05 bar	Turbinenrad	0	5
Same Value Zero	D6F003ZI2	19.07.2016 05:35	(Leer)	WS OF-Cu 203-051 HZ	Stadtwasser o. Siel	Flügelradzähler	0	5
Same Value Zero	D6F003ZI4	19.07.2016 05:35	(Leer)	WS OF-Cu 203-051 NZ	Stadtwasser o. Siel	Flügelradzähler	0	5
Same Value Zero	D6F005ZI1	19.07.2016 05:35	(Leer)	Gas 3,8bar OF-Cu ges.	Erdgas 3,8 bar	Turbinenrad	0	6
Same Value Zero	F1F205A	19.07.2016 05:35	(Leer)	HD-O2 TK2, Lanze 1	Sauerstoff 99% HD	Vortex	0	5
Same Value Zero	F1F229ZI1	19.07.2016 05:35	(Leer)	WS 105-002 HZ, TK2, Probenahme	Stadtwasser o. Siel	Flügelradzähler	0	6
Same Value Zero	F1F230ZI	19.07.2016 05:35	(Leer)	WS 105-003, TK2, Sozialwasser	Stadtwasser m. Siel	Flügelradzähler	0	6
Same Value Zero	F1F236ZI	19.07.2016 05:35	(Leer)	Gas 50mbar TK2, Heizstrahler	Erdgas 0,05 bar	Turbinenrad	0	6
Same Value Zero	G7F509A	19.07.2016 05:35	(Leer)	HD-O2 NMA Summe	Sauerstoff 99% HD	Blende	0	6
Same Value Zero	G7F608A	19.07.2016 05:35	(Leer)	Luft Netz NMA - EI	Druckluft 6 bar, trocker	Blende	0	2
Same Value Zero	H6F225A	19.07.2016 05:35	(Leer)	Gas 3,8bar SpU. Oxydul	Erdgas 3,8 bar	Vortex	0	2
Same Value Zero	F1F229ZI2	19.07.2016 05:35	(Leer)	WS 105-002 NZ, TK2, Probenahme	Stadtwasser o. Siel	Flügelradzähler	0	6
Same Value Zero	B1F019A	19.07.2016 05:35	(Leer)	HD-O2 Probenahme	Sauerstoff 99% HD	Vortex	0	7
Same Value Zero	55F204A	19.07.2016 05:35	(Leer)	Gas 3.8bar Anheizer Str.2 ges.	Erdgas 3,8 bar	Blende	0	5
Same Value Zero	55F311A	19.07.2016 05:35	(Leer)	Gas 3.8bar Anheizer Str.3 Br.1	Erdgas 3,8 bar	Turbinenrad	0	5
Same Value Zero	55F312A	19.07.2016 05:35	(Leer)	Gas 3.8bar Anheizer Str.3 Br.2	Erdgas 3,8 bar	Turbinenrad	0	5
Same Value Zero	55F313A	19.07.2016 05:35	(Leer)	Gas 3.8bar Anheizer Str.3 Br.3	Erdgas 3,8 bar	Turbinenrad	0	5
Same Value Zero	55F105A	19.07.2016 05:35	(Leer)	Gas 3.8bar Anheizer Str.1 ges.	Erdgas 3,8 bar	Blende	0	5
Same Value Zero	2139F622A	19.07.2016 05:35	(Leer)	TKS,Erdgas Konverteraufheizbrenner	Erdgas 3,8 bar	Turbinenrad	0	7
Same Value Zero	B1F205ZI	19.07.2016 05:35	(Leer)	Gas 50mbar Edelprobe Heizstrahler	Erdgas 0,05 bar	Turbinenrad	0	6
Same Value Zero	F8F010A	19.07.2016 05:35	(Leer)	DL 20bar Nm³/h Schwanenhals	Druckluft 20 bar	Blende	0	6
Same Value Zero	G7F814A	19.07.2016 05:35	(Leer)	Dampf 3bar NMA	Dampf 3 bar	Blende	0	5
Same Value Zero	A1F100ZI	19.07.2016 05:35	(Leer)	Erdgas 50mbar F+E Versuchsanlage	Erdgas 0,05 bar	Turbinenrad	1.96800005435944	3
Same Value Zero	F6F120R	19.07.2016 05:35	(Leer)	O2-MD RWO Konverter 1	Sauerstoff 95% MD	Vortex	0	4
Same Value Zero	A6F421ZI	19.07.2016 05:35	(Leer)	Gas 3,8bar, Kessel 4, Br.2 Zaehler	Erdgas 3,8 bar	Turbinenrad	0	1
Same Value Zero	A7F215A	19.07.2016 05:35	(Leer)	HD-O2 Spiess-Urania	Sauerstoff 99% HD	Vortex	0	2
Same Value Zero	A6F411ZI	19.07.2016 05:35	(Leer)	Gas 3,8bar, Kessel 4, Br.1 Zaehler	Erdgas 3,8 bar	Turbinenrad	0	1

The data source is the integrated database of PI AF

How to get the data from PI AF database
→ Data link with PI OLEDB Enterprise

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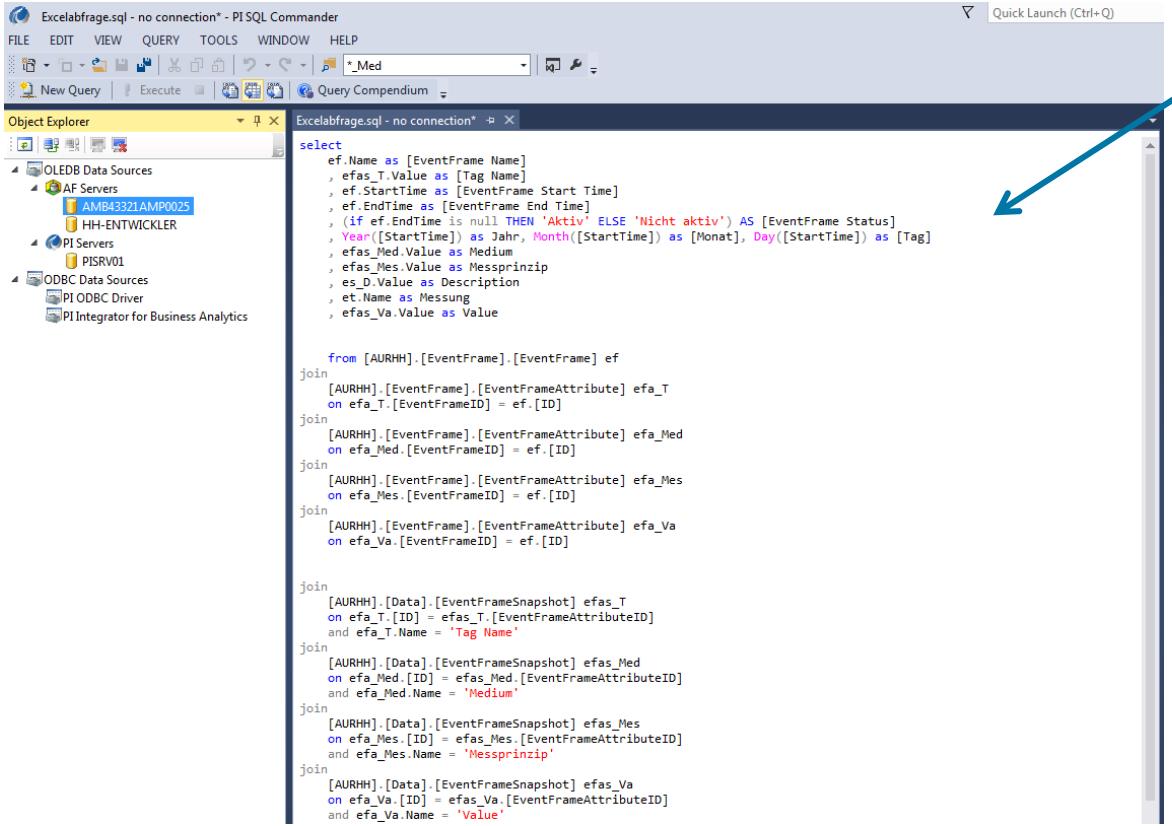

SQL-Query

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Conclusion

- All measurements can be tested fast
- Existing information from other databases can be used
- A systematic and automatic system to detect failures
- One view to monitor 3,000 measurements

How the PI System can support an Energy Management System in a copper company?

COMPANY and GOAL

Aurubis is the leading integrated copper group and the world's largest copper recycler, and wanted to **monitor all measurements systematically**.

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CHALLENGE

Monitor and analyze all energy measurements of an Energy Management System

- More than 3,000 measurements
- 50 PLCs
- More than 20 types of energy

SOLUTION

Use of PI AF

- Interconnection of PI System and EnMS SQL database
- Universal template and algorithm in PI AF
- End user interface in MS Excel

RESULTS

System is part of the EnMS

- Failure detection faster and systematic
- Less downtime
- Analysis and calculations more reliable

Contact Information

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State your **name & company**

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