Optimization of Operation and Maintenance in Thermal Power Plants using PI System

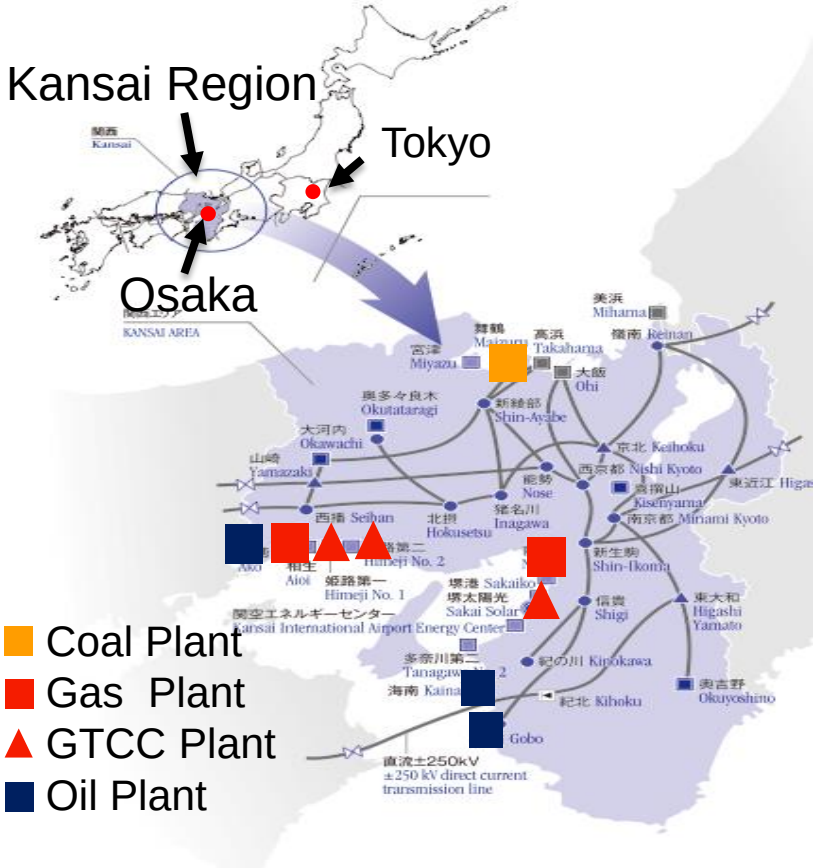
Presented by **Hiroshi Kuwahara**
Ryota Iseki

Kansai Electric Power
power with heart

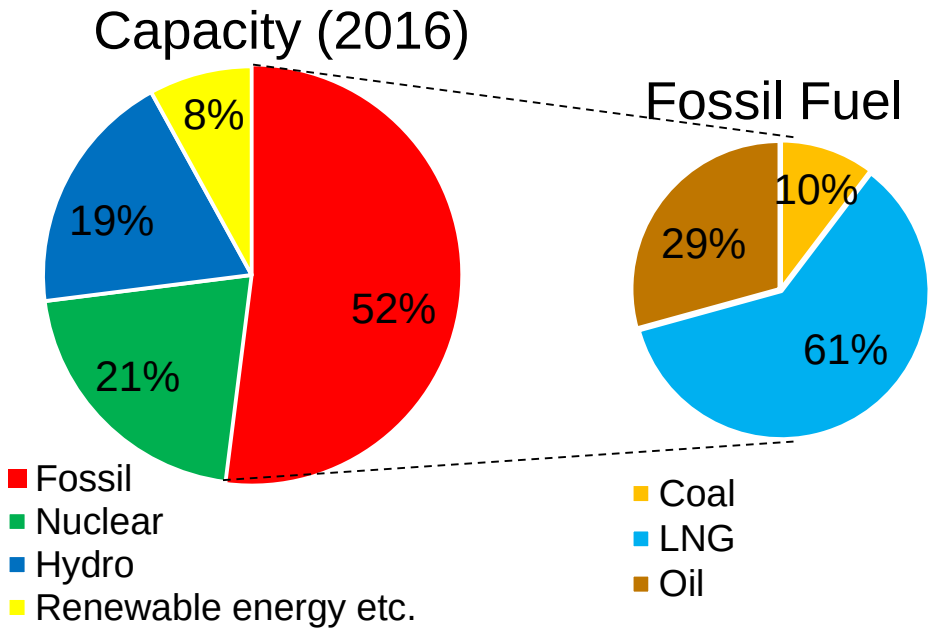
Agenda

- Overview of Kansai Electric Power
- Challenges in Thermal Power Generation
- Optimization of Operation and Maintenance in Thermal Power Plants with IoT, Big Data and AI
- Introduction of PI System to Thermal Power Plants
- Application Examples
- Expansion Plan
- Conclusion

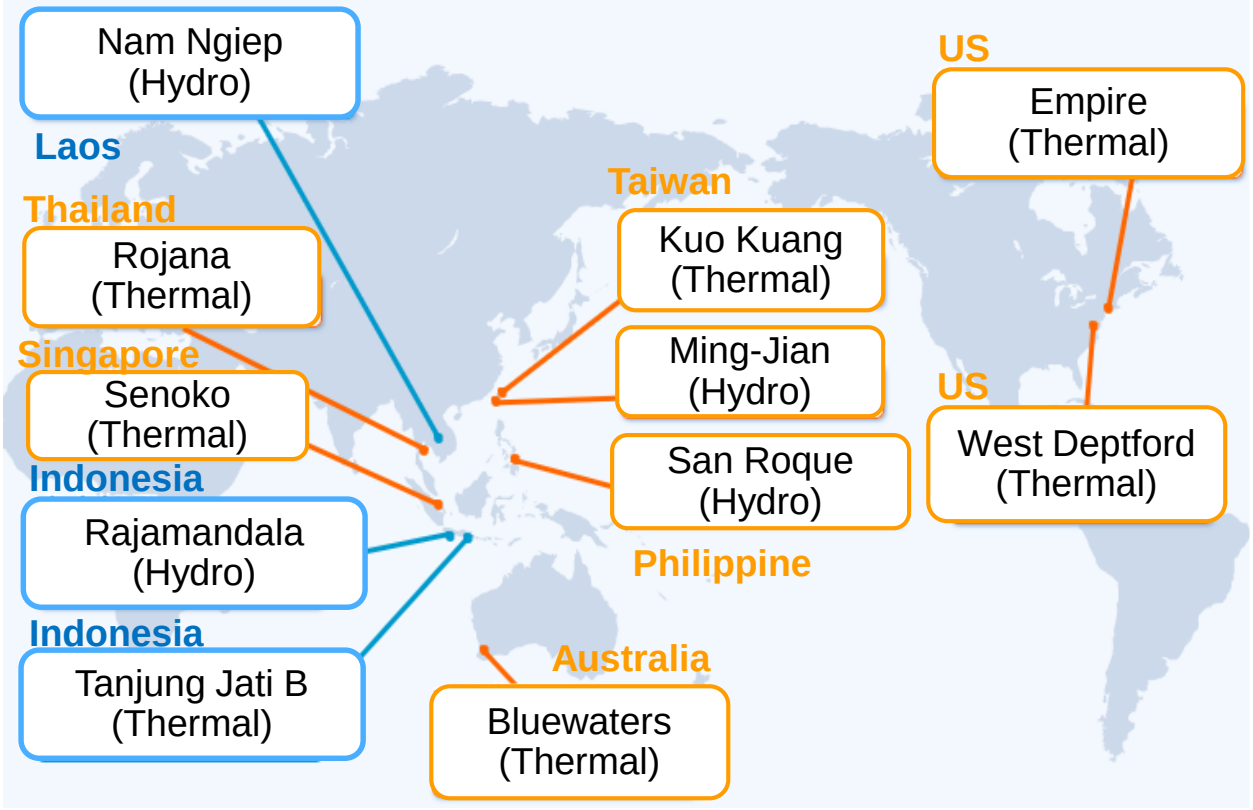
Overview of Kansai Electric Power



- Established in 1951
- Electricity Sales : 127,516 GW
- Installed Plant Capacity : 46 GW



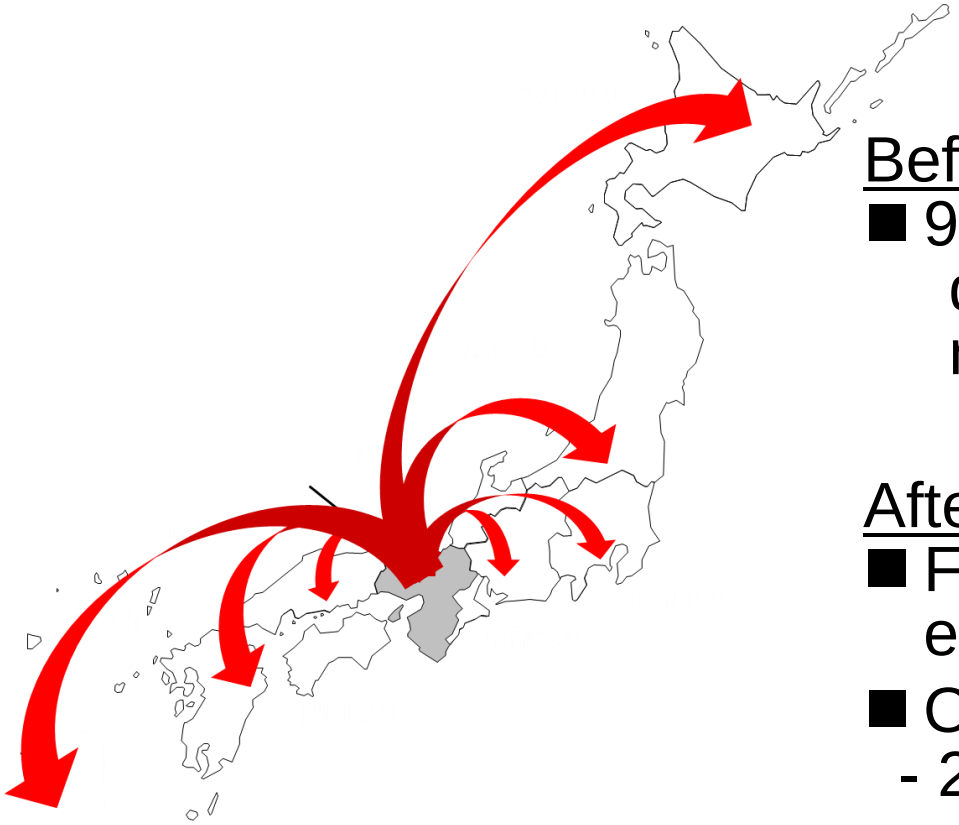
Kansai's Overseas Projects



- Total Output: 2,159 MW
  - Fossil : 1,788 MW
  - Hydro : 371 MW

Empire Power Station
GTCC, 635 MW
Rensselaer, NY, US

Power System Deregulation in Japan



Before

- 9 Electricity Power Companies dominated and controlled the market.

After

- Full liberalization of the electricity market in 2016
- Opening a new market
  - 200 billion $ market scale

Challenges in Thermal Power Generation

Optimization of Operation & Maintenance

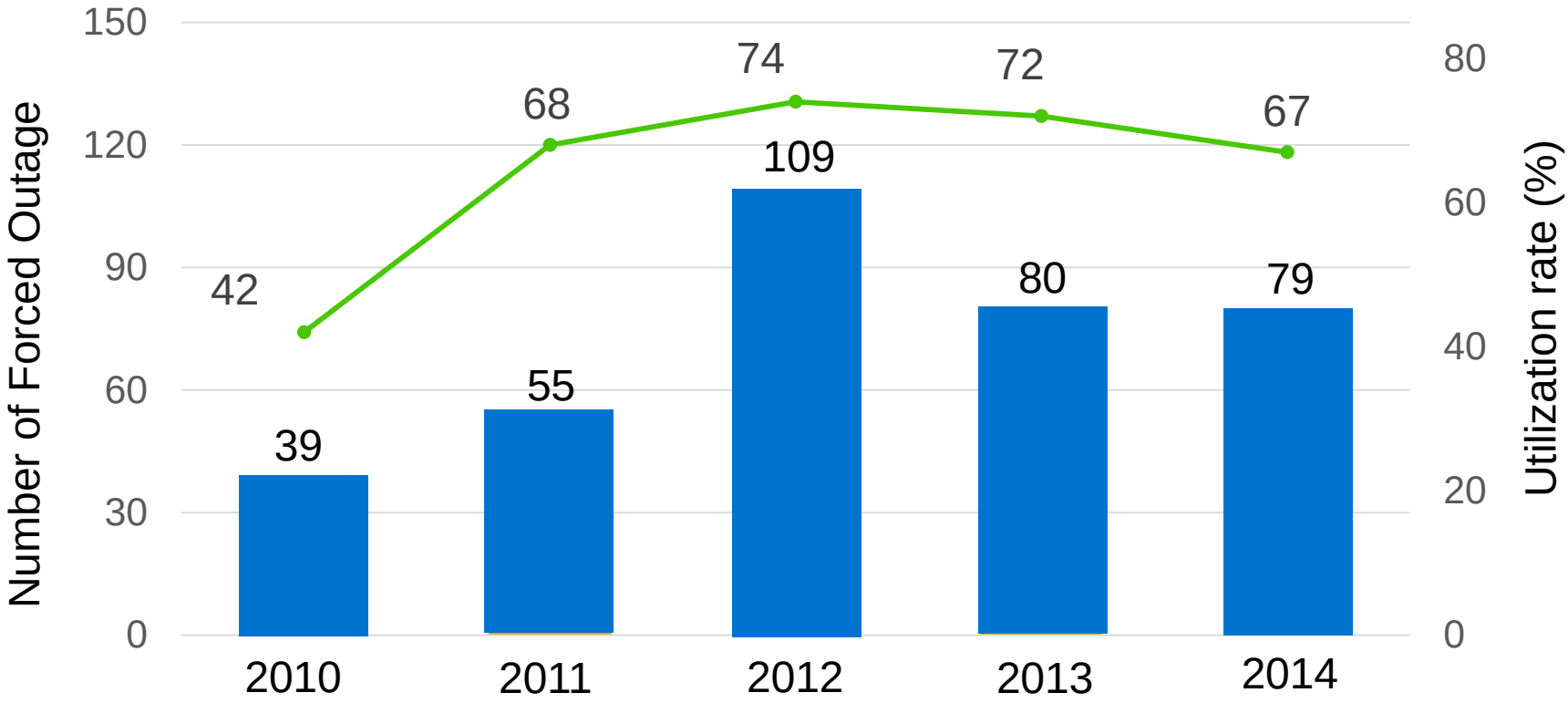
Minimizing
Forced Outage

Optimizing
Maintenance Plan

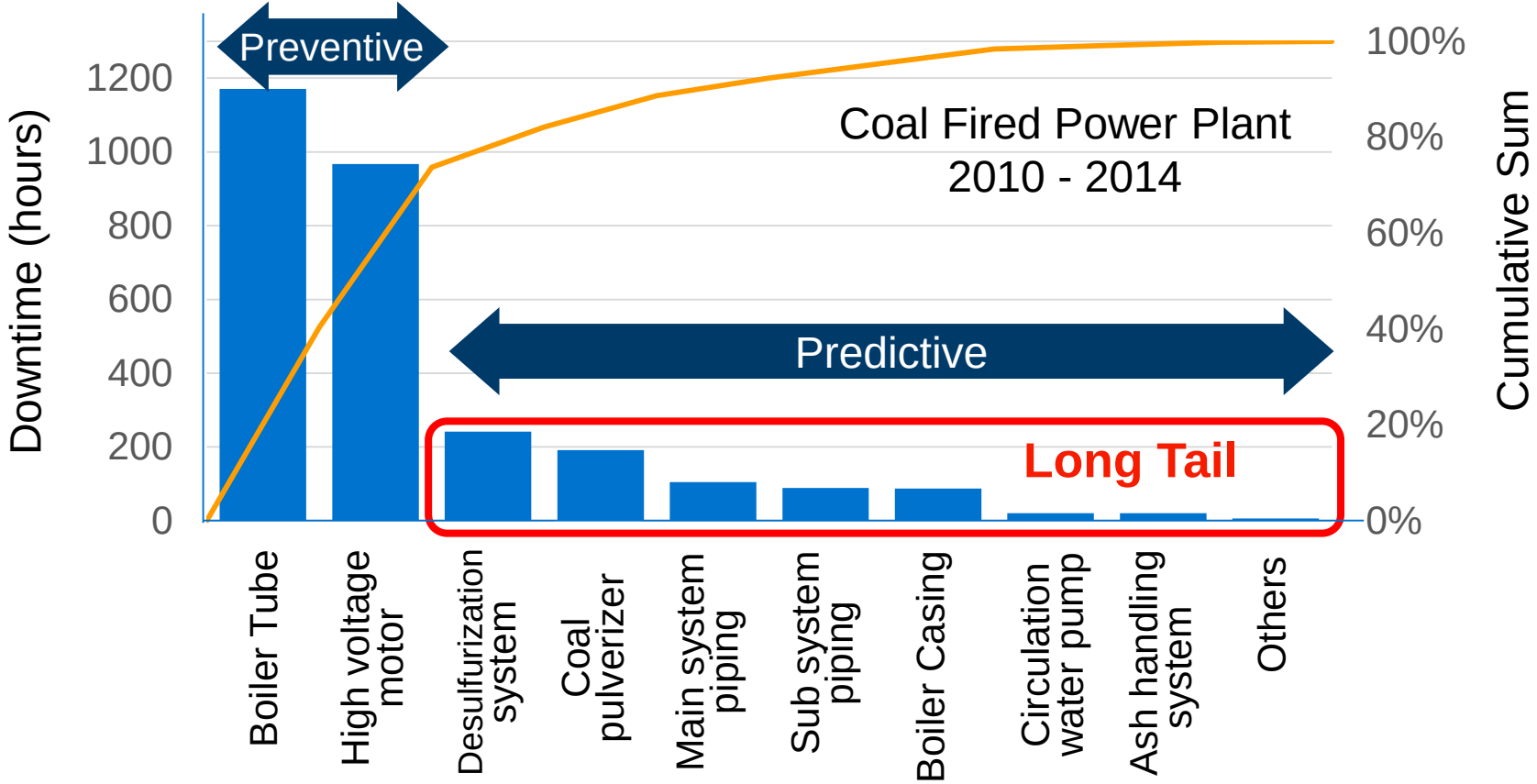
Enhancing
Plant Efficiency

To address these challenges,
We need to make the best use of enormous amount of plant operating data.

Challenges in Thermal Power Generation



Challenges in Thermal Power Generation



Optimization of O&M in Thermal Power Plants with IoT, BD & AI

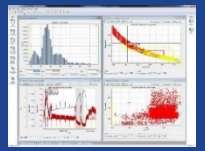
Optimization of Operation & Maintenance

Minimizing
Forced Outage

Optimizing
Maintenance Plan

Enhancing
Plant Performance

BD Analytics with AI



+

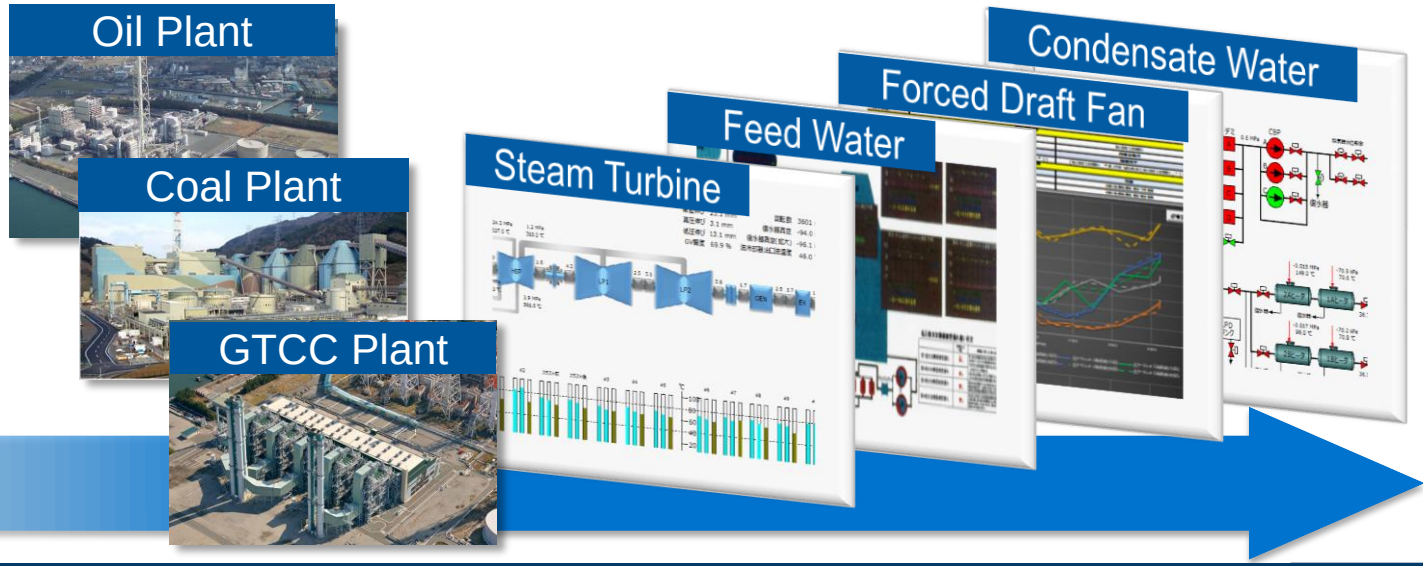
IoT devices

Data Management Infrastructure - PI System

Expertise | **Operating Data** | **Knowledge & Experience**

Introduction of PI System to Thermal Power Plants

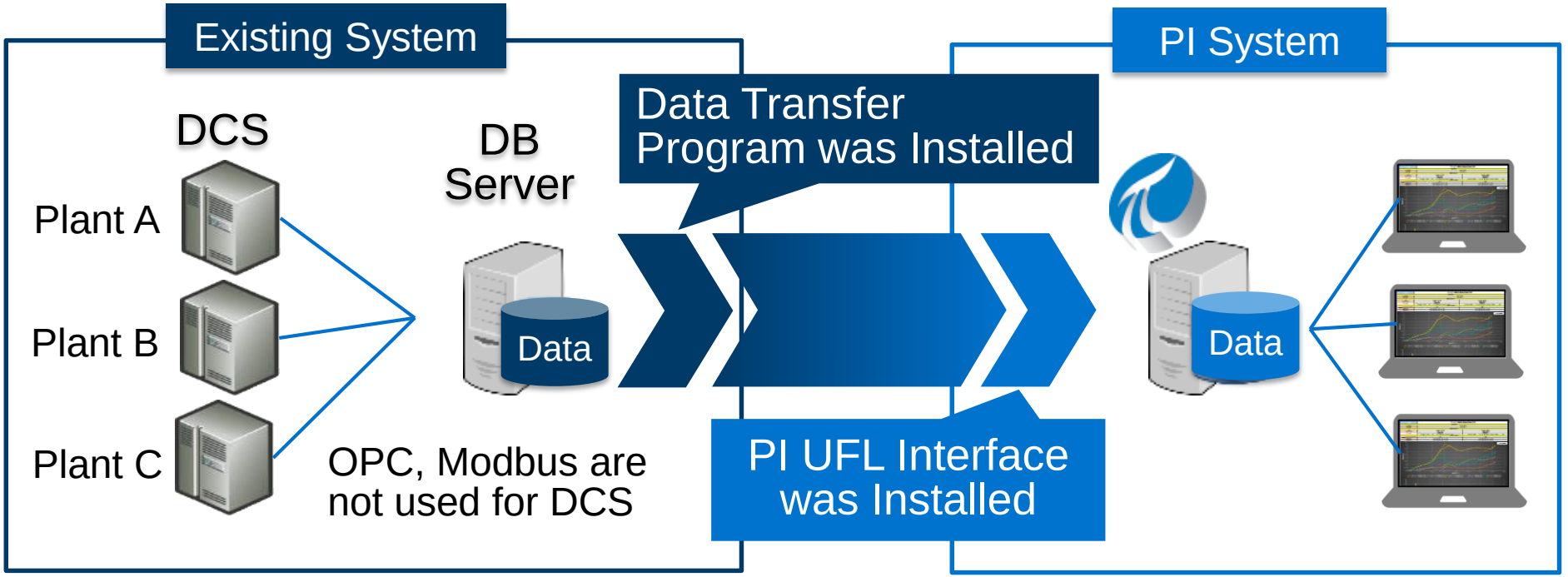
2015	2016



- Build the system in two months.

- Deployed to 3 Power Plants / Coal, Oil & GTCC Plants
- Create 200 + surveillance screens

Introduction of PI System to Thermal Power Plants



It took only 2 months to install PI System in our existing plants.

Condition Monitoring

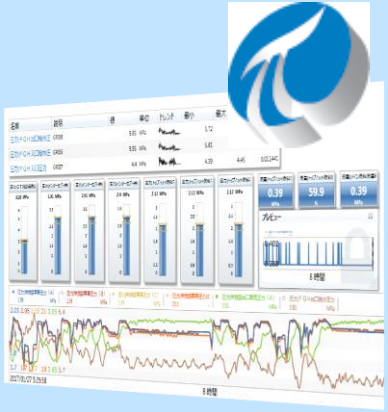
We have …

- Operation Data
- Knowledge
- Know-how

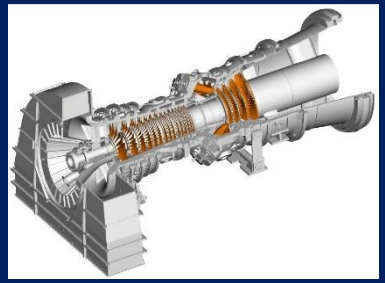
and etc.

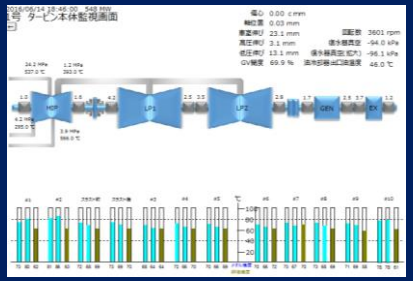
OSIsoft has …

- PI System
  - ProcessBook
  - DataLink
  - Coresight



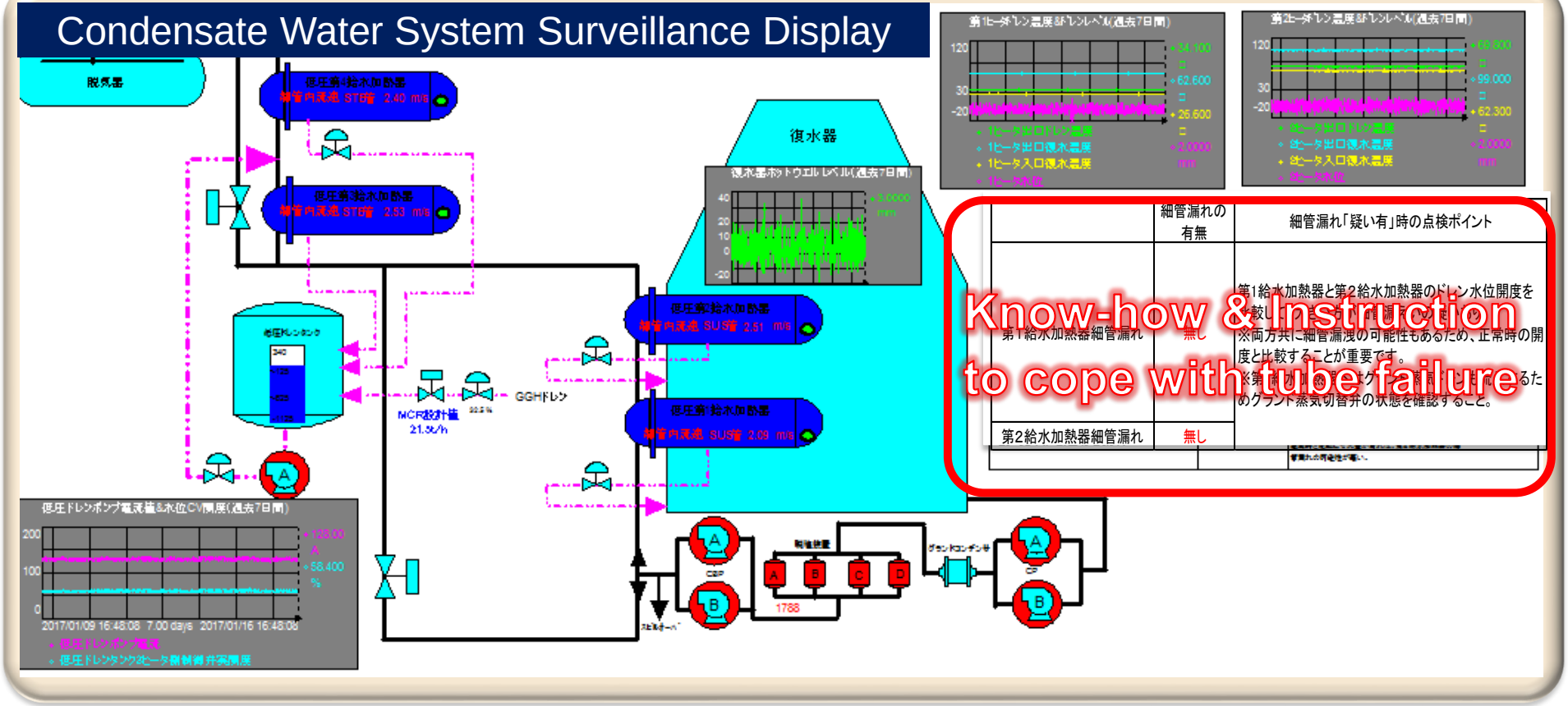
Enhancing Condition Monitoring





Ensuring Expertise Transfer

Example - Condition Monitoring on Heat Exchangers



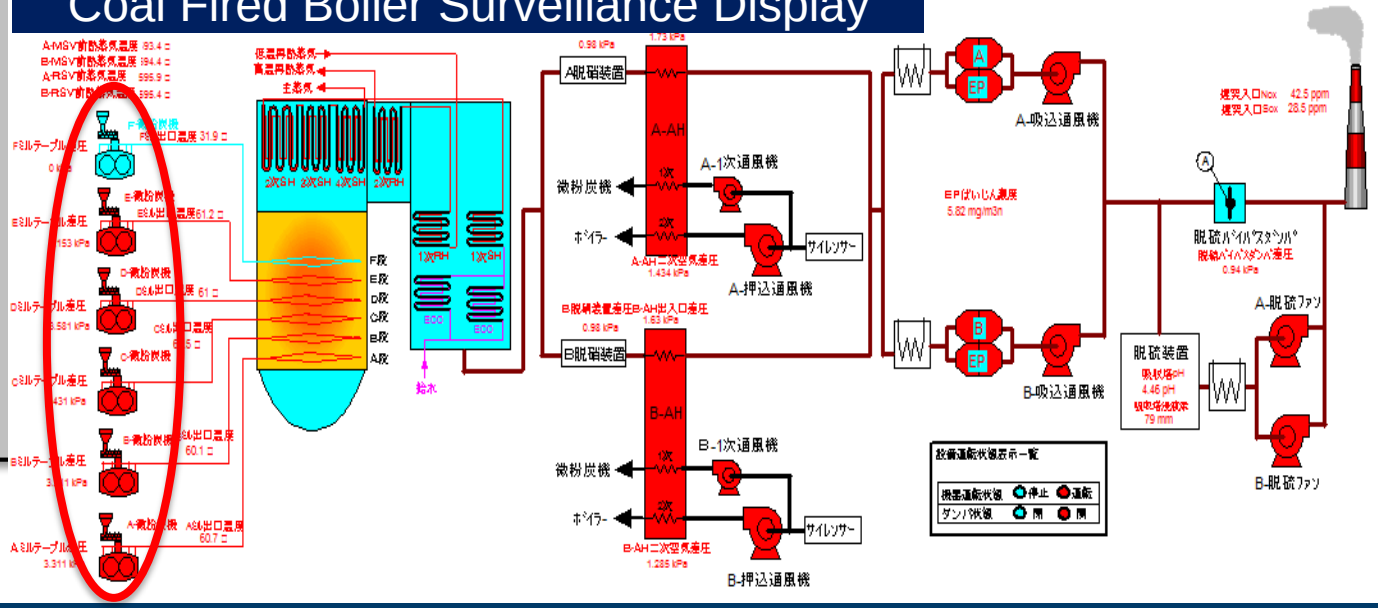
Example – Condition Monitoring on Coal Mill

Display for Pre- Alarms

Aミル	Bミル	Cミル	Dミル	Eミル	Fミル
ミル差圧	ミル差圧				
0.057 kPa	2.862 kPa				
ミル電流	ミル電流				
0.1 A	139.4 A				
ミル振動	ミル振動				
1.3 μm	24.8 μm				
ローラリフト	ローラリフト				
0.51 mm	10.62 mm				
ローラ加圧	ローラ加圧				
0.04 MPa	7.5 MPa				

Coal Mill

Coal Fired Boiler Surveillance Display



- Setting pre-alarm based on past failure data for earlier anomaly detection.
- Adding a single pre alarm to existing system costs US$ 10,000 / in PI System US$ 0 !

Life Estimation of Crucial Equipment

TBM : Maintenance Intervals recommended by Manufacturers. **Past**

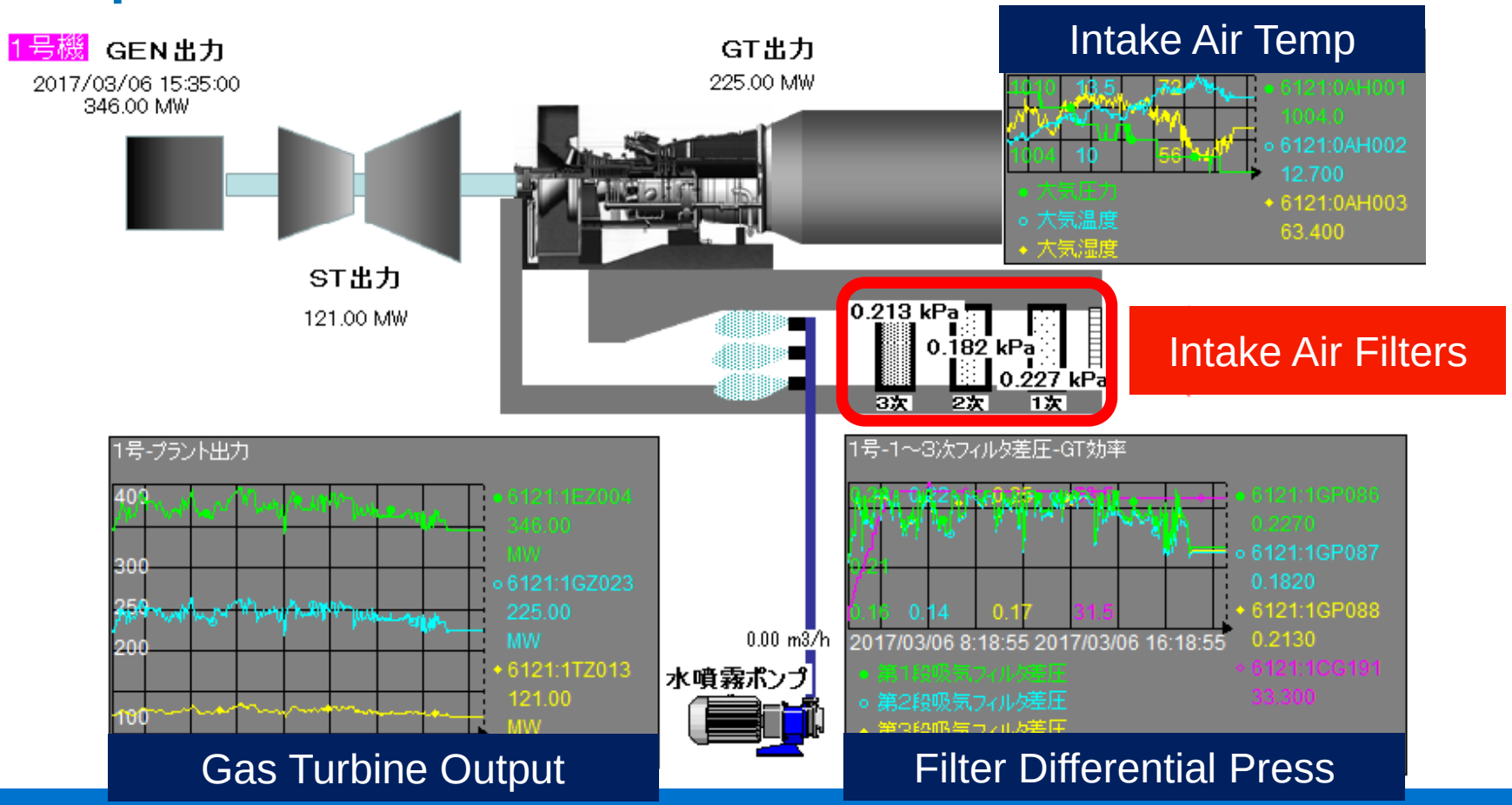
TBM > CBM **Present**

- Now in the process of transition to CBM…

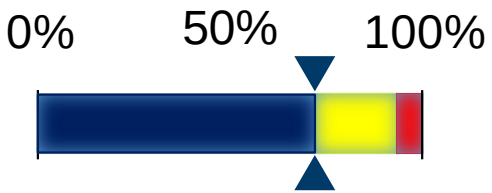
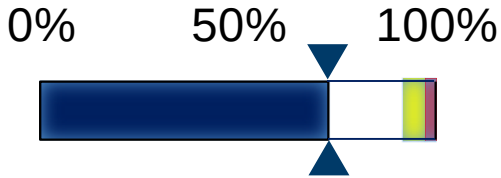
TBM < CBM : Optimize Maintenance Management **Future**

- Extend equipment lifetime based on real-time condition monitoring & inspection records.

Example - Life Estimation of Gas Turbine Inlet Air Filters



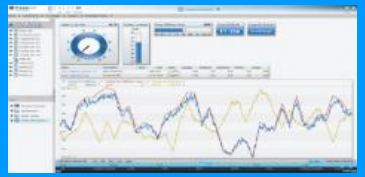
Example - Life Estimation on Components of Crucial Equipment

Component	Monitoring Parameter	Remaining Lifetime	Overhaul Schedule	Lifetime Consumption Rate
 Bearing	Operating Time	3,600 h	Jul.2020	
 Solenoid Valve Stem Nut	Number of Open & Close	7,200 h	Jul.2020	

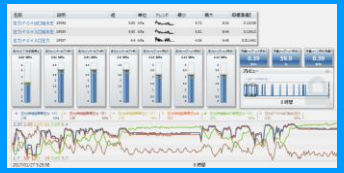
Optimize overhaul schedule of crucial equipment based on monitoring deteriorating condition of the mechanical weak point of them.

Further Projects

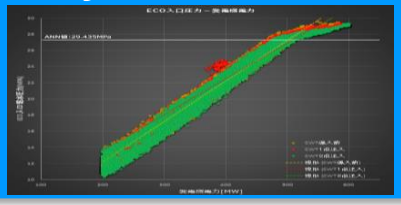
Performance Optimization



PI System Tools



Anomaly Detection Tools



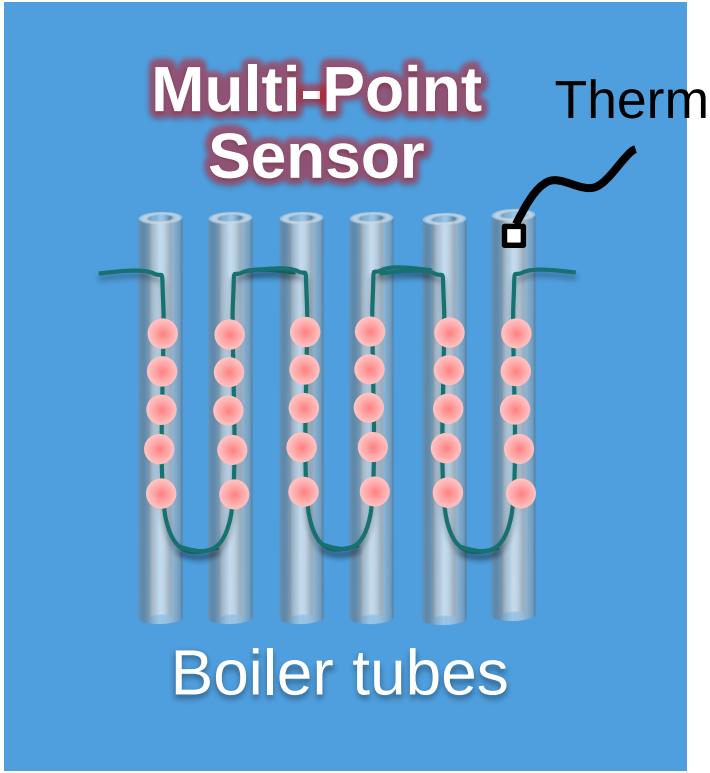
PI System / Collect · Store · Visualize

Plant Computers

Process Instruments

IoT devices

Use of high-tech sensor devices
- Multi-Point sensor for Boiler Super Heater tubes



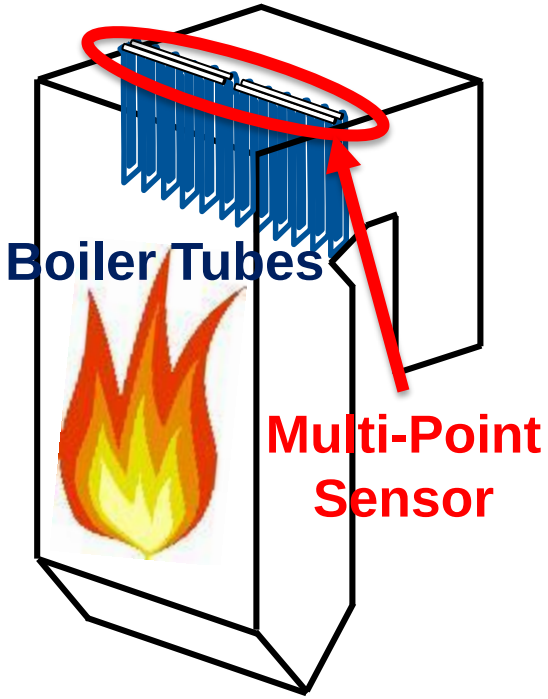
Thermocouple

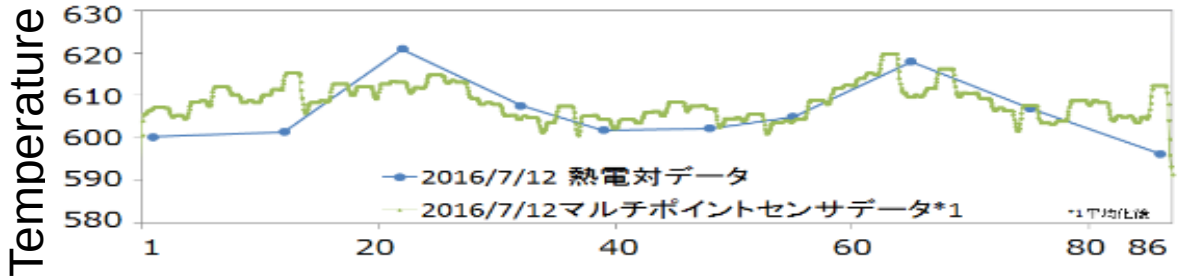
- Single-Point Measurement

Multi-Point sensor

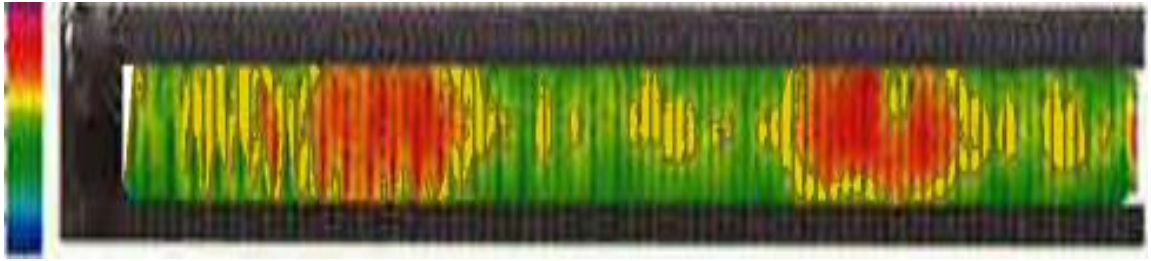
- Multi-Point Measurement enables
  - More accurate lifetime estimation
  - Earlier anomaly detection

Use of high-tech sensor devices
- Multi-Point sensor for Boiler Super Heater tubes





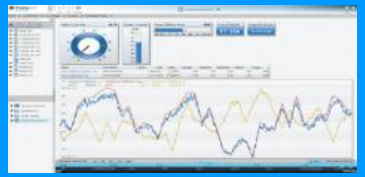
Boiler Tube Panel Location



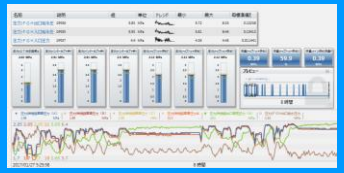
Temperature of Boiler Tube Panel Surface

Further Projects

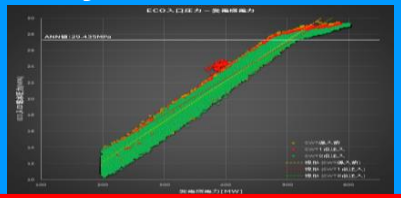
Performance Optimization



PI System Tools



Anomaly Detection Tools



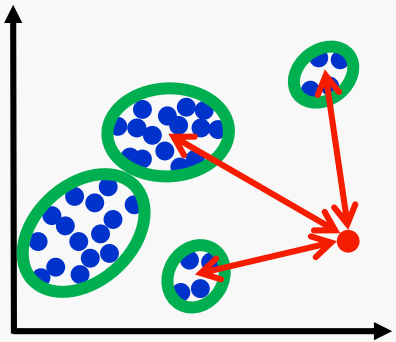
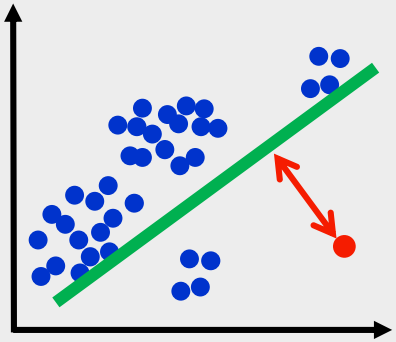
PI System / Collect・Store・Visualize

Plant Computers

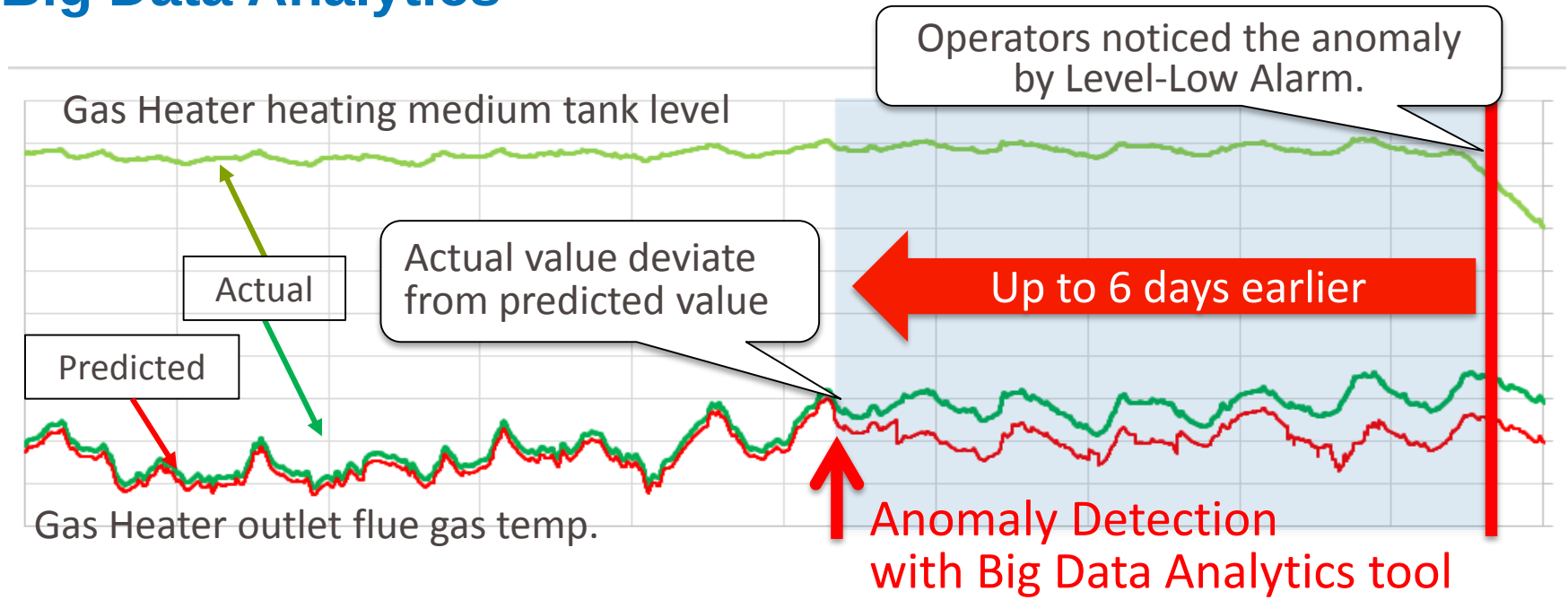
Process Instruments

IoT devices

Big Data Analytics for Anomaly Detection

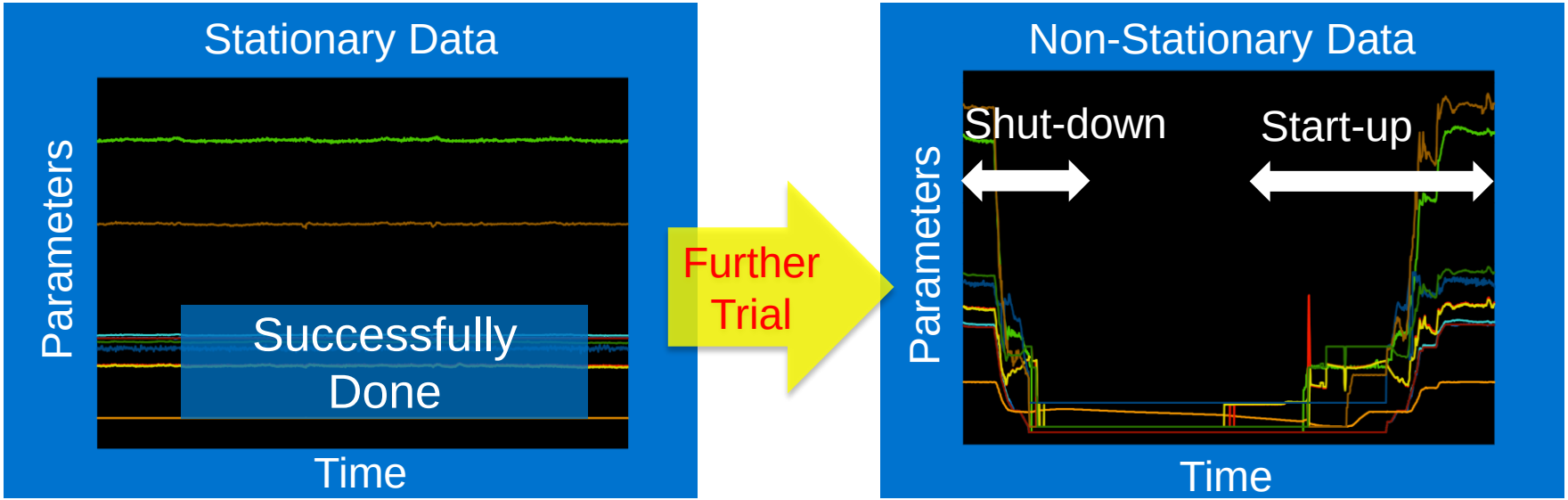
Technique	Schematic Diagram	Method / Theory
Classification		Clustering
		Adaptive Resonance Theory
		Pattern Recognition
		Deep Learning
Regression		Multiple-regression
		Invariant
		Self-regression
		Mahalanobis - Taguchi

Big Data Analytics



With BD analytics tools, the anomaly was detected 6 days earlier than operators actually had noticed it.

Big Data Analytics

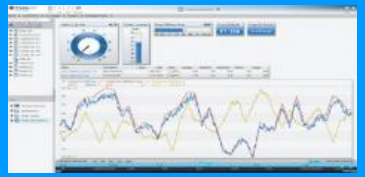


Further Trial

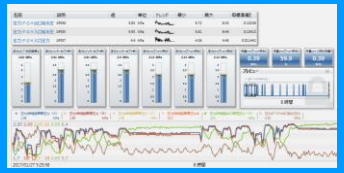
To verify whether or not the tools can detect anomaly even while plant load changes or plant is in start-up & shut-down operation.

Further Projects

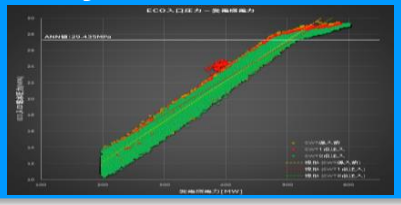
Performance Optimization



PI System Tools



Anomaly Detection Tools



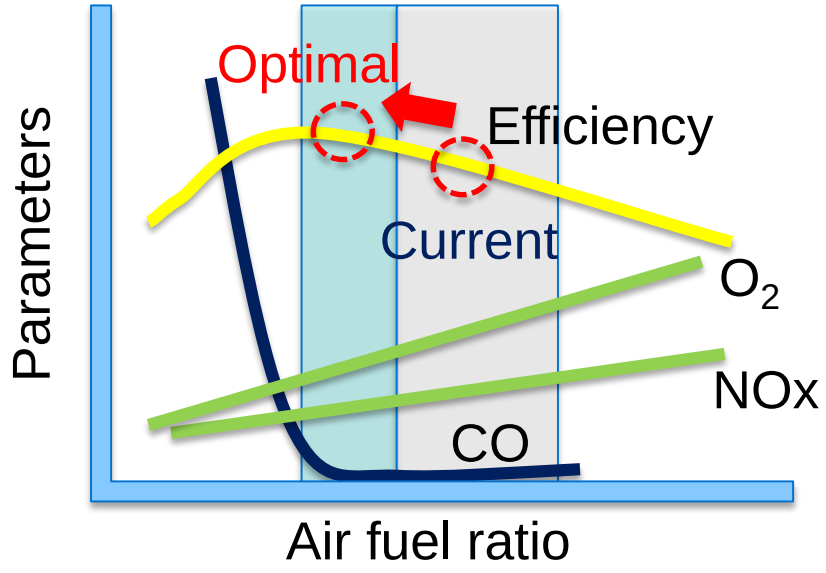
PI System / Collect · Store · Visualize

Plant Computers

Process Instruments

IoT devices

Plant Operation Optimization System



- Reduction of excess air rate
- Combustion optimization with image recognition technology
- Steam temp optimization
- Soot blowers optimization

Efficiency Improvement >>> 0.1% abs. UP

Expansion Plan - PI System

2015	2016	2017
Planning	Trial and Evaluation	Deployment to all PPs

Headquarters

Maizuru

Sakaikou

Akoh

Himeji No.2

Nanko

Gobo

Himeji No.1

Aioi

2017
To be installed
to all Power Plants

Summary

COMPANY and GOAL

1) Kansai Electric Power
2) To be the foremost Power Company in Japan. Competing successfully in the power market.

Kansai Electric Power
power with heart

CHALLENGE

To maximize optimization of O & M at our thermal power plants.

- Minimizing forced outages
- Optimizing maintenance plan and time,
- Making plant operations more efficient.

SOLUTION

To merge our knowledge and expertise in O & M with recent remarkable developments in digital technology.

- PI System
- IoT devices
- Big Data Analytics tools

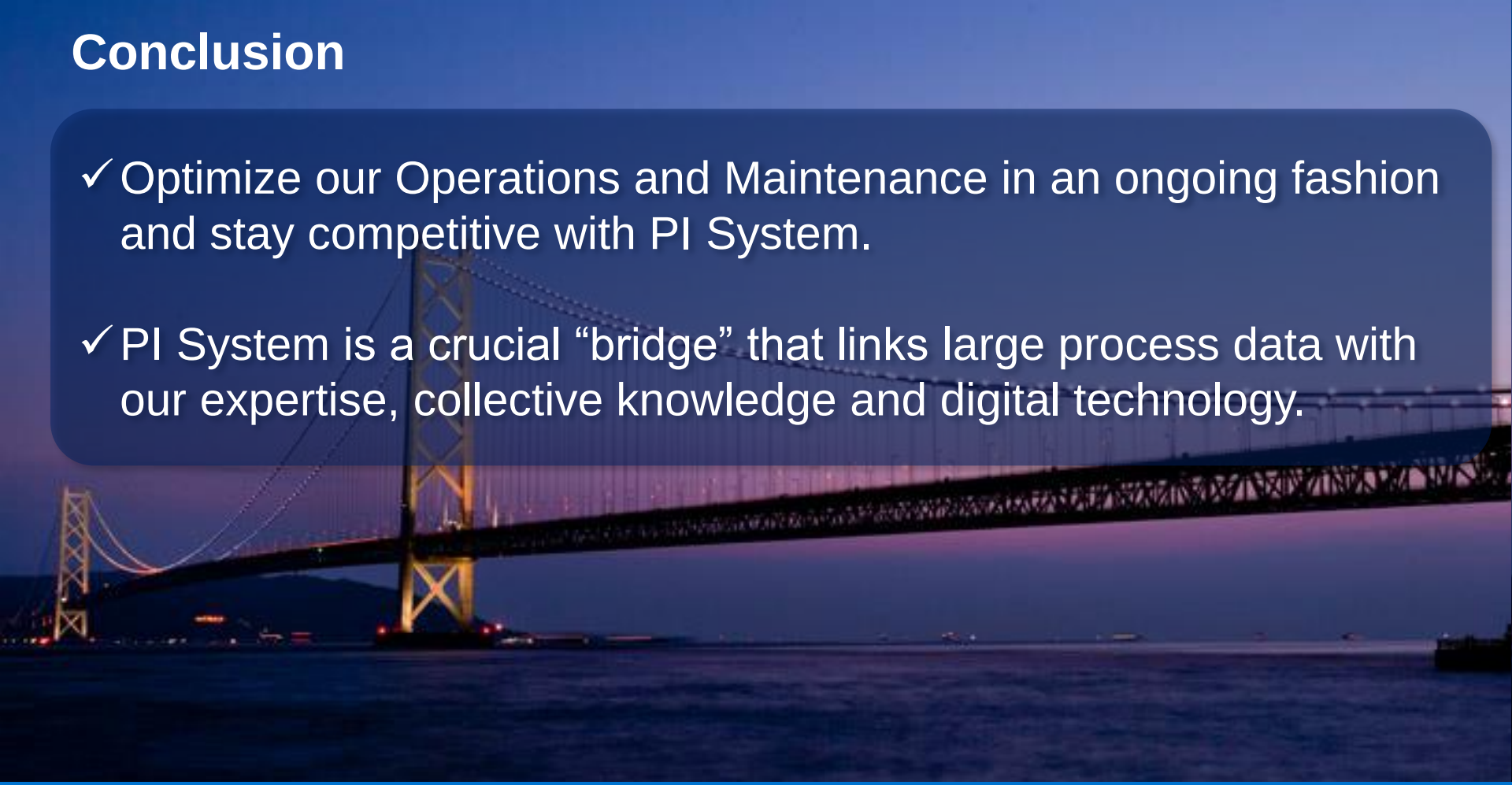
RESULTS

We confirmed that it is possible to reduce O & M costs by using the PI System and its high compatibility with sensor devices and Big Data Analytics tools.

- Strengthening condition monitoring
- Switching from TBM to CBM
- Conducted the verification of Multi-point sensor, anomaly detection tools and operational improvement software.

Conclusion

- ✓ Optimize our Operations and Maintenance in an ongoing fashion and stay competitive with PI System.
- ✓ PI System is a crucial “bridge” that links large process data with our expertise, collective knowledge and digital technology.



Contact Information

Hiroshi Kuwahara
kuwahara.hiroshi@c2.kepco.co.jp
Thermal Power Division
The Kansai Electric Power Co.,Inc.

Ryota Iseki
iseki.ryota@b5.kepco.co.jp
Thermal Power Division
The Kansai Electric Power Co.,Inc.

Questions

Please wait for the **microphone** before asking your questions

State your **name & company**

Please remember to…

Complete the Online Survey for this session

http://bit.ly/uc2017-app

감사합니다

谢谢

Danke

Gracias

Merci

Thank You

ありがとう

Спасибо

Obrigado