Digital Transformation of Thermal Power Plants using the PI System

From the Kansai Electric Power, Tadahiro Nakazawa, Akira Kozakai
Agenda

- Overview and Business Environment of KANSAI Electric Power
- Optimization of O&M at our Thermal Power Plants
- Development of New Products and Services
- “Value Creation” Services for Domestic and Overseas Power Producers
- Summary
Overview and Business Environment of Kansai Electric Power
Company General Information (FY2016)

- Established in 1951
- 2nd largest EPCO * in Japan

Kansai
- Osaka
- Kyoto
- Kobe...

- Established in 1951
- 2nd largest EPCO * in Japan

Himeji #2 P/S
- CCGT
- 2,919MW

Maizuru P/S
- USC Coal Fired
- 1,800MW

- 27B US$ REVENUE
- 121 TWh ENERGY SALES
- 36.6 GW TOTAL CAPACITY
- 19 THOUSAND EMPLOYEES
- 65 YEARS EXPERIENCE
- 19 GW THERMAL CAPACITY

*capacity of power-generating facilities
Overseas IPP Projects

Ireland: Evalair
223MW Wind
Kansai: 24% since 2017

Taiwan: Ming-Jian
17MW Hydro
Kansai: 24% since 2005

Singapore: Senoko Power
3,300MW
(CCGT:2810, Conventional:490)
Kansai: 15% since 2008

Taiwan: Kuo Kuang CCGT
480MW CCGT
Kansai: 20% since 2006

Philippines: San Roque
436MW Hydro
Kansai: 50% since 1998

Laos: Nam Ngiep Hydro
(291MW, 45%)

Indonesia: Tanjung Jati B EXP.
(2140MW, 25%)

Thailand: Rojana SPP
505MW (CCGT Co-generation)
Kansai: 39% since 2003

Australia: Bluewaters
459MW (Coal-fired)
Kansai: 50% since 2013

Indonesia: Rajamandala Hydro
(47MW, 49%)

US (New York): Empire
635MW CCGT
Kansai: 20% since 2006

Kansai: 25% since 2017

US (New Jersey): West Deptford
768MW CCGT
Kansai: 17.5% since 2016

Kansai: 24% since 2008

US (Pennsylvania): Hickory Run
(1000MW, 30%)

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COUNTRIES

9

IPP PROJECTS

13

TOTAL NET CAPACITY

2.57 GW

THERMAL NET CAPACITY

2.15 GW
Business Environment

Before
- 10 Electric Power Companies dominated and controlled the market.

After
- Full liberalization of the electricity market in 2016
- Opening a new market - 200 billion USD market scale
Our Business Growth Vectors

**Existing**

- Enhance Existing Business Profits
  - Reform Cost Structure
    - O&M Optimization
    - Fuel Conversion

**New**

- Develop New Services & Products
  - Integrate our Know-How with Advanced Digital Technology
    - Operation Optimization using AI

**New Markets**

- Provide Solution Services
  - Engineering Services
  - O&M Support

- Challenges to New Field
  - Provide New Services & Products to New Markets
    - Remote Monitoring Service
Optimization of O&M at our Thermal Power Plants
Installation of PI System to All Thermal Power Plants

- **2015**
  - Built the system in two months.

- **2016**
  - Deployed to 3 Power Plants / Coal, Oil & GTCC Plants
  - Created 200+ surveillance displays

- **2017**
  - Installed to All Power Plants
  - Started Remote Monitoring Service for overseas plant
Challenges in optimizing O&M at thermal power plants

Performance
- Enhancing plant power output and efficiency
- Operation Optimization

Availability
- Anomaly Detection
- Unplanned Down Time Reduction

Optimized Maintenance
- CBM
- Optimized Maintenance Planning

Data Management Infrastructure – The PI System

Operating Data
Sensors, Digital Devices
Knowledge, Experience
Example – Down-Time Reduction

- Early anomaly detection by intensive monitoring of plant’s weak points
Example – Down-Time Reduction

- Predictive monitoring by intensive real-time trends and pre-alarm function
- Recovery Planning by utilizing integrated equipment information
Monitor parameters relevant to the lifetime of equipment and estimate the remaining lifetime for a proper maintenance plan.
Example – Performance Improvement with AF 1

Boiler Heat Balance

- Heat balance at each HEX
- Boiler Efficiency
- Fuel Enthalpy

Advanced Real-Time Monitoring of Boiler Performance
Optimize the control of the spray water flow in HRSG superheater
## Cost Savings at CCGT Plant with the PI System

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td><strong>Plant Performance Improvement</strong></td>
<td>Monitoring of GT Intake Air Filter Differential Pressure</td>
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<tr>
<td></td>
<td>GT Performance Monitoring (Fine-tuning of IGV setting)</td>
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<td>Monitoring of Economizer Inlet Water Temperature</td>
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<td></td>
<td>Monitoring of Fuel Gas Heater Outlet Gas Temperature</td>
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<tr>
<td><strong>Unplanned Down Time Reduction</strong></td>
<td>Monitoring of Circulation Water Pump</td>
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<td></td>
<td>Monitoring of IGV</td>
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<tr>
<td><strong>Maintenance Cost Reduction</strong></td>
<td>Equipment Remaining Life Management</td>
</tr>
<tr>
<td><strong>Quality Improvement</strong></td>
<td>Automation of Performance Test Record Collection</td>
</tr>
</tbody>
</table>

- Estimate approx. $3,000,000 / year cost savings at our CCGT Power Station
Development of New Products & Services

**Existing**

- Enhance Existing Business Profits
  - Reform Cost Structure
    - O&M Optimization
    - Fuel Conversion
  - Expand Business Domain
    - Provide Solution Services
      - Engineering Services
      - O&M Support

**New**

- Develop New Services & Products
  - Integrate our Know-How with Advanced Digital Technology
    - Operation Optimization using AI
  - Challenges to New Field
    - Provide New Services & Products to New Markets
      - Remote Monitoring Service
Boiler Operation Optimizer Using AI

- Apply to our coal fired power station in 2018 and provide this system for domestic and overseas customers
“Value Creation” Services for Domestic and Overseas Power Producers
What is K-VaCS?

- Master plan creation support
- Basic design support
- Support for improving operations performance/
- Program to improve operational and maintenance skills/
- Support for enhancing facilities maintenance
- Re-Powering: Support for the replacement of aging facilities
- Operations Readiness: Support for detailed design, procurement, construction and commission
- EPC: Support for Operations readiness
- Operation & Maintenance: Support for improving operations performance/
  Program to improve operational and maintenance skills/
  Support for enhancing facilities maintenance
Remote Monitoring Center
Remote Monitoring Service

Bluewaters Power Station in South West Australia

Internet

Real-time Operating Data

K-VaCS

Technical Support & Best Solutions

PI System

Expert Operators

Analytic tool with AI

Real-time Operating Data

Technical Support & Best Solutions

Analytic tool with AI
Collaboration between Kansai Electric Power and OSIsoft

**Kansai Electric Power**

- Power with heart
- **PI System Adoption Support**
  - Consulting Service for Introduction
  - Preparation of Surveillance Displays
  - Creation of Anomaly Detection Models

**OSIsoft**

- PI System Installation
- Product Training
- Customer Support

**Customer**

- O&M Optimization
- Efficient Operation
- High Availability
- Maintenance Cost Reduction

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Summary

COMPANY AND GOAL
Kansai Electric Power is the 2nd largest power company in Japan, and our goal is to be the foremost power company competing successfully in the power market.

CHALLENGE
1) To maximize optimization of O&M at our power plants.
   • Minimizing forced outages
   • Optimizing maintenance plan
   • Making plant operations more efficient.
2) To Develop “Value Creation” services for Japanese and overseas customers

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
1) Estimated cost savings by $3,000,000 / year through improving plant performance, reducing unplanned down time and O&M cost reduction.
2) New Services
   • Boiler optimization with AI
   • Remote monitoring service
   • Support for the PI System adoption
Contact Information

**Tadahiro Nakazawa**
nakazawa.tadahiro@b4.kepco.co.jp
Thermal Power Division
The Kansai Electric Power Co., Inc.

**Akira Kozakai**
kozakai.akira@e5.kepco.co.jp
Thermal Power Division
The Kansai Electric Power Co., Inc.
Thank You

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